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Closing of Isolated Plants

THE FOLLOWING LETTER FROM THE CONSERVATION BUREAU OF THE UNITED STATES FUEL ADMINISTRATION WAS HANDED A. P. CONNOR, SPECIAL WASHINGTON REPRESENTATIVE OF POWER PLANT ENGINEERING, BY CHARLES E. STUART, CHIEF OF THE POWER AND LIGHT SECTION, WHICH CLEARLY EXPLAINS THE POSITION OF THE ADMINISTRATION ON THE SUBJECT OF CLOSING OF ISOLATED PLANTS.

Arthur L. Rice, Editor,
Power Plant Engineering,
537 South Dearborn Street,
Chicago, Ill.

July 22nd, 1918.

Dear Sir:—

The Conservation Bureau has inaugurated certain programs to effect the conservation of fuel. The Skip-stop System for street railways is one of them. A very large portion of the street railways of the country has already adopted this system. It is resulting in the saving of many thousands of tons of coal per annum. It will not be long before practically the entire country will have adopted this system.

The connection of existing waterpower plants with existing steam power systems so that the loads from the steam stations may be transferred as far as possible to the water power stations will permit of further conservation of fuel.

In communities where there are several ice manufacturing plants, arrangements are being made to close as many of them as possible during the low temperature months, so as to operate at full and economic capacity as few of the plants as may be needed to supply the community with its requirements. Those companies, whose plants are closed down, will secure their supply from the operating plants. Thus they do not lose their commercial identity or contact with their patrons. This will effect not merely a large saving in fuel, but a very considerable saving in ammonia, which is much needed for war purposes.

You are familiar with the lightless night order and other similar orders. These orders result in direct curtailment of the use of power, which means fuel.

There are other lines along which the Conservation Bureau is working, which are both sensible and effective, in the efforts to save fuel, and among these is a program for closing down uneconomical isolated electric plants.

Some criticism has been directed at this particular line of effort, and I am constrained to believe from what I have read of such criticisms that in each and every case the critic has not had a full understanding of the aims and methods of the Conservation Bureau. Neither do the critics seem to have at their disposal any data to corroborate the criticisms.

There is no general program for the closing down of isolated plants because they are such; neither is there any desire or intention to increase the loads on central power stations for any other than the single purpose of saving fuel, when the transfer of a load of an isolated plant to the central station plant actually accomplishes that purpose.

This particular field of activity is so broad that requests have been made publicly to the

owners of uneconomical plants to stop their operation, either in whole or in part, as the particular cases require, for the period of the war, when investigations by the Management show that the service rendered by these isolated plants could be duplicated by more economical plants at a lesser expenditure of fuel. In additions to this method, investigations are being made through the state organizations of specific plants, and where the findings warrant any action, the request is made that the particular plants close, placing their load on some other more economical plant. However, in all cases, every effort is made to apply the "rule of reason," and not to ask any sacrifice on the part of anyone, unless the results to be accomplished adequately justify such a request, and so far as we know, in each and every case the closing down has been an actual benefit to the plant so closed.

In cases where isolated plants are in position to use exhaust steam from the generating units for useful purposes whatever they may be, and where they accomplish the generation of current and the use of steam for heat at the same or nearly the same expenditure of fuel as would be accomplished with the service rendered in some other manner, such plants are not asked to close. In cases where the service rendered by some outside source either in whole or in part can accomplish an actual saving of fuel, a request to close down is invariably made, and when the circumstances are known, such requests have been willingly complied with.

Up to the present time no complaints by the owners or by the managements of small isolated plants against this program have reached the Fuel Administration in Washington. On the contrary, we have received word in a number of cases from such owners commending our efforts along these lines and giving the figures to show the savings which have been or are being effected.

For the purpose of discussion, isolated plants may be divided into two classifications: first, those which furnish electric service only. Unquestionably, the majority of such plants can purchase their electrical requirements from public utilities at a satisfactory rate, and effect a very marked saving in fuel; second, those including what are sometimes called "mixed plants." That is, those furnishing electricity and also exhaust steam for purposes applied in many ways. Many of these mixed plants can render their whole service on a fuel basis which does not lend itself to any economic betterment by purchasing its electrical requirements from the outside, and these plants are not asked to close; but even in the case of mixed plants it very frequently happens that electricity can be purchased from the outside to advantage from the standpoint of fuel conservation, and incidentally from the standpoint of saving money to the plant owners.

We have a report from one company which states that when the plant was in full operation, 3575 tons of coal were used annually in generating its electrical requirements and furnishing exhaust steam for necessary purposes. Later, when buying the needed electrical energy from a central station, 1072 tons of coal were burned for heating and other manufacturing purposes, and estimating the coal burned in the central station at $2\frac{1}{2}$ lb. per kw.-hour, which is a fair estimate in in this case, there was a net saving of 1430 tons of coal.

In all cases the endeavor is made to use the greatest care, and determine that an actual conservation will be effected before any attempt is made to close any operating plant and no sacrifice is asked for that is not commensurate with the results to be obtained. If the owners of any plants who have been asked to close feel that they have not been dealt with fairly and properly, will bring their case to the attention of the Fuel Administration at Washington, the case will be thoroughly investigated and action taken in accordance with the merits of the findings.

I would call your attention to the potential coal shortage which the country is facing, and to the effect of such a shortage on war and non-war industry, man-power as well as personal comfort. You will have observed the drastic curtailment measures of the Allied countries, the action which Canada is prepared to take towards those failing to utilize power in the most efficient manner, and it has been our desire to avert more serious alternatives through the appeals which we have made and the measures adopted along the lines which we regard as presenting the minimum of sacrifice. We are endeavoring to treat cases presented to us on their merit and to ask nothing that the public interest as a whole does not justify, and so far, our appeal, which has been a patriotic appeal, has been responded to in spirit. We have met with resistance to an exceedingly small extent, and then only from quarters where there exists a lack of information.

Very truly yours,

United States Fuel Administration,

P. B. NOYES,

Director of Conservation.

Sawdust and Wood Burning

A Symposium Dealing with Furnace Designs, Conditions to Maintain, Conveying and Storage Systems, and Value of Sawdust and Wood as Fuels

IN many wood working plants the burning of sawdust and slabs has been done in boiler furnaces more with the object of getting rid of the refuse than using it as fuel for steam generation. During the present scarcity of the usual forms of boiler furnace fuels, however, these refuse have a marketable value as fuel and in some districts cordwood may be used to advantage in power plants.

The problems presented in burning this kind of fuel are considerably different from those encountered with coal. To get best results the furnaces must be built to suit the fuel used, which may be sawdust and shavings alone or mixed with cordwood or coal, or the furnace may be required to burn wood in some form part of the time and coal as an auxiliary fuel. To burn wood successfully, that is, to get the heat value out of the fuel without making smoke and keep the steam pressure within reasonable limits requires rather delicate handling of fuel supply and draft dampers and as much careful thought and attention as when burning coal.

Data which are given below should prove of value to those contemplating the use of wood as fuel as well as to those who are at present operating wood burning furnaces. The opinions and thoughts of several engineers who have had experience with this form of fuel are given here, together with the descriptions of successful systems.

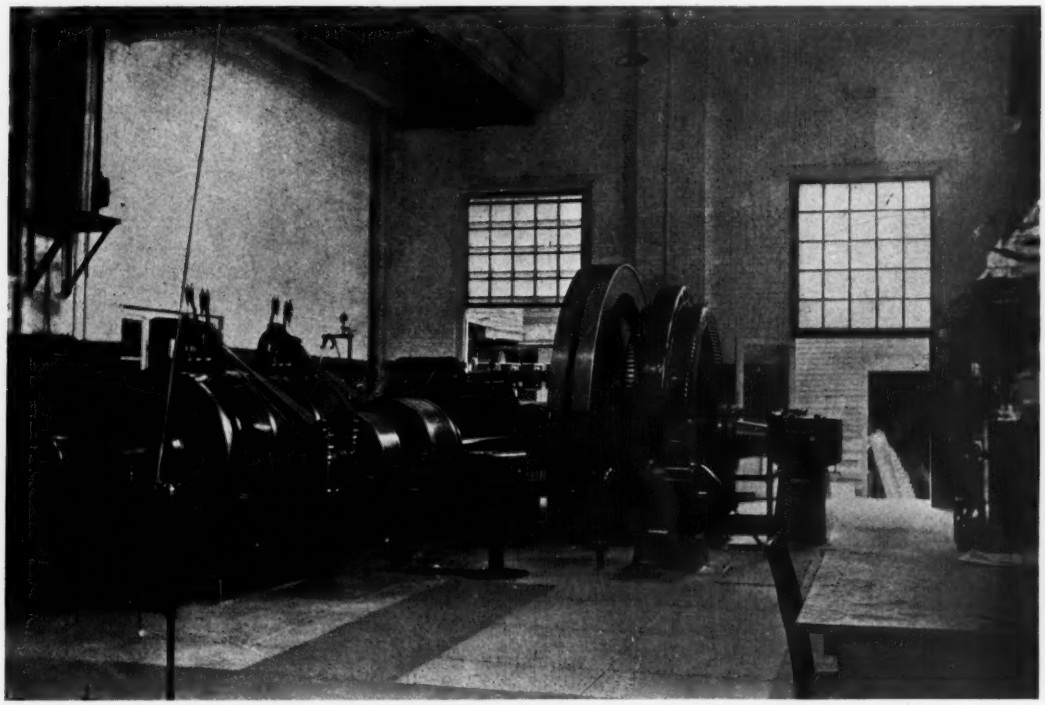


FIG. 9. PRINCIPAL GENERATING UNIT IN CURTIS BROS. & CO.'S PLANT

Conserving Fuel

C. C. Hermann.—In many manufacturing establishments refuse piles up, combustible material piles here and there in every nook and corner of the shop. It seems as if the refuse never vanishes, yet all the time it is being conveyed, or should be conveyed, to the boiler room. If you have a wood working department, your amount of refuse is great and in this particular kind of refuse lie dormant many thousands of heat units that can be made to work for you, bringing up your water temperature and supplying your steam. It is this particular kind of refuse that the writer wishes to discuss in this article.

Wood, science tells us, is a vegetable tissue which has not undergone a geological change. Some time in the prehistoric age vast forests stood where now we find our great coal fields. This change from forests to coal fields has taken thousands of years, attended by destructive distillation, resolving the organic matter into its constituents, carbon, hydrogen, oxygen and other elements in varying proportions. The various stages these forests have gone through are, wood fiber, peat, lignite, earthy brown coal, bituminous coal, semi-bituminous coal and anthracite coal, the degree of evolution being dependent upon the factors of time, depth, disturbance of beds and the intrusion of mineral matter resulting from the disturbances.

Wood is usually classified as hard wood and soft wood. Hard woods are oak, maple, birch, hickory, walnut and beech. Soft woods are pine, fir, spruce, elm, chestnut, willow and poplar. The heat value pound for pound of soft wood is found to be slightly greater than

that of hard wood, contrary to general expectation. Newly cut wood contains from 30 to 50 per cent of moisture. When dried in the atmosphere for about a year, the moisture content will be reduced to from 18 to 20 per cent and when dried in a kiln for from 90 days to 3 mo., depending upon the size of the wood, the moisture content will be reduced to from 5 to 17 per cent. Following is a table showing the ultimate analysis and calorific values of dry wood with a moisture content of about 20 per cent:

ULTIMATE ANALYSIS AND CALORIFIC VALUES OF DRY WOOD
(GOTTLIEB)

Kind of wood	Carbon	Hydrogen	Nitrogen	Oxygen	B.t.u. per lb.	Ash
Oak	50.16	6.02	0.09	43.36	8316	0.37
Ash	49.18	6.27	0.07	43.91	8480	0.57
Elin	48.99	6.20	0.06	44.25	8510	0.50
Beech	49.06	6.11	0.09	44.17	8591	0.57
Birch	48.88	6.06	0.10	44.67	8586	0.29
Fir	50.36	5.92	0.05	43.39	9063	0.28
Pine	50.31	6.20	0.04	43.08	9153	0.37
Poplar	49.37	6.21	0.96	41.60	7834	1.86
Willow	49.96	5.96	0.96	39.56	7926	3.37

Nature is indeed very kind to us in that she has converted wood to coal and therein raised the heating value of the prehistoric forests to a great extent. The

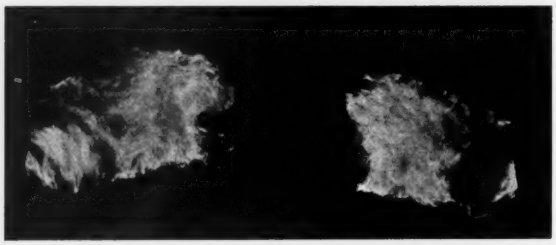


FIG. 1. VIEWS OF A SAWDUST FIRE

heating value of wood is commonly taken as equivalent to 0.4 that of bituminous coal, and although this is true, it is nevertheless much more economical at present to burn the wood refuse now than to allow it to pile up and turn to coal, a process involving from 10 to 100 thousand years. The problem confronting us then is how to handle this refuse to the best advantage so that it can be burned under the control of the attendants.

Furnace Regulation and Fuel Handling

The writer has had considerable experience in burning wood shop refuse and knows the problem of regulation to be difficult. Either not enough shavings and sawdust are delivered to the fire or too much is delivered, filling up the fire box and choking the fire. Another trouble arising from poorly designed systems is the distribution on the grate and frequently the grate surface is not in proper proportion to the boiler heating surface. Average practice gives one square foot of grate surface to 4 or 5 boiler horsepower when burning 150 lb. of fuel per hour containing 30 to 40 per cent moisture. Figure 1 shows pictures of the flame and fire in the combustion chamber of a dutch oven type of boiler setting taken when about the above ratio was maintained. The doors of the fire box were opened and the pictures taken. The flame is long and unbroken, lapping well over the bridge wall. A successful way to obtain even distribution of the fuel in the fire box is to make a conical rise in the bottom of the inlet box. This has a spreading effect and throws fuel well into the corners of the fire box, preventing grate exposure which results in fire bed leaks.

There are hours of the day when more shavings and sawdust come from the wood shop than the grate surface can accommodate, and if no storage place is provided, a waste of fuel is the result. Some plants take care of the excess by means of a bypass to a bin near the boilers. A much more satisfactory way of handling the excess is by overhead storage and a means of conveying the material to the boilers as needed. Instead of piping the vortex directly to the fire box, the vortex should deposit the material into a conical bin, as shown in the sketch, Fig. 2, overhead and near the front of the boilers. Referring to Fig. 2, A is the conical bin, made of sheet iron, capacity to suit the requirements; B is a vertical shaft, running in bearings, G, having on its upper end a cam H and between the bearings a pulley F. The part of the shaft within the bin has a number of rods C, which form an agitator. D is the inlet pipe from the vortex

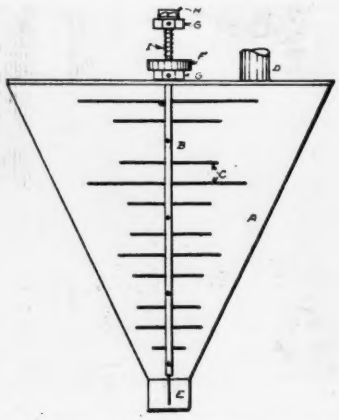


FIG. 2. SAWDUST BIN PROVIDED WITH AGITATOR

and E is the outlet pipe to the furnace. The outlet or discharge pipe is equipped with a gate valve for closing off the supply and preventing fire from entering the bin through the discharge pipe. The shaft B has a revolving motion taken from the source of power by the pulley F, also a vertical motion given it by the cam H. As the shaft revolves it rises over the stationary cam and drops into the jaw; this motion will cause the sawdust and shavings to dislodge, falling through the opening E. I is a spring of ample compressive strength to prevent the agitator from lifting, also forcing it down when over the jaw of the cam.

It is sometimes necessary to supply air below the discharge E to carry the material through the opening in the boiler front. In case this is found necessary, an air bypass may be had by tapping the main fan exhaust pipe just before it enters the cyclone or vortex. This connection should be made on top and should be long, giving a scooping effect, the pipe coming away at an angle of about 15 deg. in the direction of flow. The lower end of the bypass should connect in the same manner, that is, in a long tapering connection. The bypass

should also be supplied with a gate to adjust the volume of air going into the furnace. There should be just enough air to carry the fuel free of the setting so as to leave the draft free.

In Fig. 3 are photographs of shavings fed by a screw conveyor. The photographs show the inside of the storage bins looking down from the top. The bins were rectangular on top, the sides sloping in at the bottom to a half circle or trough in which a 9-in. screw conveyor was placed. No agitators were provided. By close examination of the pictures, you can see how the sawdust and shavings bridged over, holding up the entire mass and resulting in no feed for the conveyor. By measuring, it was found that material settling in the bin for 2 or 3 hr. would bridge over and hold up with a bridge 4 ft. across.

Wood Burning Equipment

L. T. Hill.—Manufacturers are turning more and more nowadays to the subject of waste utilization, and in the smaller lumber manufacturing or wood working operations probably the best way to utilize this waste is through the medium of fuel. There have been a great

FIG. 3. SAWDUST BRIDGED OVER SCREW CONVEYOR

many disadvantages connected with the burning of shavings; there was always a lot of litter lying about with a consequent increase in insurance rates; then there has been no satisfactory method of storing this fuel and part of the time shavings had to be used and part of the time something else. The question then arises as to the best and most economical method of handling these shavings and it is on this subject that I think a few words at this time will not be amiss.

Two things to be considered in making an installation are, first, initial cost, and, second, to get a system that is as nearly automatic as possible to cut down on man power which we must conserve now as much as anything else.

The dutch oven furnace is the type best adapted for handling shavings and sawdust, though the standard type of furnace may be used very successfully. A very satisfactory installation is to concentrate all of the fuel in a reinforced concrete fuel house, run a sawdust chain through the floor of this fuel house and over the top of the dutch oven furnaces at a height of about 7 ft. This chain will run in a trough all the way; in the fuel house, equip this trough with a sliding cover so that amount of fuel to the chain may be regulated. At a point in the trough immediately above the hole in the top of the furnace, cut out the side and bottom and put in a short wooden chute, say 18 in. long. Equip this chute on the inside with a sheet iron slide working in grooves and making an angle of 60 deg. with the chute, to regulate the amount of fuel to furnace. At the bottom of this chute put a galvanized iron trough, running to the hole in the furnace. It is also advisable to make this entire fuel drive an individual unit so that in case of shutdown in the mill the steam plant will not be affected. This arrangement is as nearly automatic as can be made and one fireman can take care of a number of boilers.

This arrangement is not so satisfactory when used with a standard furnace, as gravity will not give the proper distribution to the shavings unless the furnace has an extra good draft. If there are only one or two standard furnaces to be fired, I would suggest erecting a fuel house immediately back of the furnaces and about

FIG. 4. CYCLONES ON ROOF OF CURTIS FACTORY

8 ft. distant; this should be equipped with vertical sliding iron doors, immediately opposite the furnace doors. Midway between the furnace and the fuel vault erect a cyclone and let the outlet leg be branched so that one side will lead into fuel vault and the other side branch again as many times as may be necessary to supply the furnaces each at two points. The pressure from the cyclone is just enough to give proper distribution to the shavings. Two-way valves should be located at each branch of the pipe, all adjustable from the fireman's position. This gives a system that is automatic as long as the mill is in operation and in case of shutdown there is a supply of fuel that can be fired by hand. One cyclone erected in this manner will take care of one or two furnaces. There are installations where one cyclone supplies three furnaces, but this is not as satisfactory as where it supplies only one or two.

There is another installation that is often used in connection with what might be called the "gravity system" first described and that is to locate the fuel trough as above, but let the galvanized iron trough to the

furnace be air tight. A small blower can then be connected with these fuel lines and a pressure of 1 or 2 lb. will be sufficient to secure proper distribution in the furnace and yet is not enough to make a forced draft and will not give any appreciable back pressure provided the air line joins on to the fuel line at an angle as near 180 deg. as may be possible.

The first two systems, or slight modifications of them, are those most commonly used; their first cost is low, their upkeep practically nothing, they are both nearly entirely automatic and they make allowance for a surplus of fuel stored in a concrete house, conforming with insurance regulations.

FIG. 5. VIEW IN BOILER ROOM OF CURTIS PLANT

A number of wood working plants figure that they can make more money by selling their cutoffs and trims for wood and buying coal for fuel than they can by putting these trims through a hog and burning them; but if they will really figure on this, they will find that by using all their waste as fuel they can make their steam plant self-sustaining and thus aid in the conservation of both men and material, which is what we must all figure on at this time more than at any other.

Shavings Burning at Curtis Bros. & Co.'s Plant

Among the power plants which have met with success in using wood refuse as fuel, is that of Curtis Bros. & Co., of Clinton, Ia. This is a wood-working plant that furnishes mill work to the building trade, so that the fuel is always kiln dried. The general scheme of the fuel supply system is to gather all sawdust and shavings by means of fans, deliver them together with chips from the hog, that chops up refuse edgings, to a cyclone over a storage bin. A chain feed conveys the fuel from the bin to the furnaces which are fed continuously through gravity chutes.

The grates are of the inclined hand-stoker type, which are adapted to the use of coal as well as wood refuse. The entire sawdust system is automatic, the chain feed being controlled in speed by the steam pressure in the boiler working through a damper regulator. The fireman's duty consists principally in regulating the amount of fuel carried by the chain and adjusting the feed to the individual furnaces so as to secure proper distribution of load among the boilers. The fuel burns with practically no smoke and what little ash is left is in the form of slag.

Inasmuch as this system has proved so thoroughly successful and the equipment is so complete, the following details will undoubtedly be of interest.

Source of Fuel

In the mill building are four floors used for factory purposes. On the first floor the rough lumber is sawed into desired lengths, planed, sorted and delivered by elevator to the other floors where finished products are turned out. A double 60-in. Sturtevant fan conveys the sawdust and chips from suction headers at each machine to the cyclone on the roof. This fan is driven by a 50-hp. motor direct connected to the shaft and located between the fan housings.

The second floor is provided with a double 55-in. belt-driven fan, the capacity of the motor being 35 hp. One side of this fan handles sawdust and chips, delivering them to the large cyclone, while the other side collects the dust from the sanders and delivers it to the small cyclone. Most of the sander dust is screened and sacked for sale, the remainder, however, goes to the furnaces.

On the third floor is a double 50-in. motor-driven belt connected fan which delivers to the cyclone; and on the fourth floor, a 72-in. fan direct connected to a 35-hp. motor collects the dust from the machines, also the discharge from the large cyclone and part of that from the small cyclone, and delivers to a cyclone over the storage bin at the power house.

In the system of dust collection, each wood working machine is provided with one or more hoods, at which the draft maintained is 1¾ to 2 in. of water. The large cyclone on the mill roof is 192 in. in diameter and has three inlet ducts, two of which are 28 in. in diameter and one 24. This, as previously stated, handles sawdust, shavings and chips from the first, second and third floors, delivering to the relay fan on the fourth floor. The other cyclone is 120 in. in diameter and handles only sander dust, which is conveyed to it through a 24-in. duct. From this cyclone are two discharge ducts, one to the sifter and sacker, the other to the discharge from the large cyclone. On this sander dust cyclone is a hood specially designed to keep out rain and snow when the sander fan is not in operation.

From the relay fan a 28-in. duct, 200 ft. long, conveys the sawdust to the cyclone over the storage bin in the power plant. This cyclone is 120 in. in diameter

and also takes the chips from the hog and a 30-in. planer fan.

The fuel prepared for the furnace by the hog consists of blocks and edgings. The blocks are carried from the basement of the factory building to the third floor of a lumber cut stock building by a chain conveyor. Here they fall upon a grating which separates out chips, nails, bolts, etc. The blocks are assorted at this point, those fit only for fuel are thrown into a chute leading to a bin from which they are delivered to the hog, any surplus blocks go to a loading chute and are sold.

Edging strips are loaded on stake buggies, from which they are hoisted to the chute, then delivered to the hog. A 35-hp. motor drives the hog, which is a No. 3 C. R, manufactured by Mitts & Merrill, and the 36-in. fan which delivers the chips to the power plant cyclone. In case of necessity, the motor may be tripped by a string from the mouth of the feeding chute. A gravity damper in the discharge duct from this fan prevents dust from filling the duct when the hog is not in use.

Storage Bin and Conveyor

At the power plant, the sawdust discharges from the cyclone to a V-shaped hopper or bin with a capacity of 8600 cu. ft., which is sufficient for three days' fuel supply; or in case of failure of the conveyor, the fuel may be diverted directly to chutes leading to two of the furnaces. Conveyor trouble has required this to be done only once during the year the system has been in operation.

Much of the success of this system depends upon the operation of the conveying apparatus which delivers the fuel from the bin to the furnace; the plan adopted is, therefore, the result of a great amount of study and experimentation. The conveyor consists of a standard malleable iron sawdust or refuse chain 190 ft. long, 12 in. wide with 6-in. pitch, designed for 6000 lb. working strength. It is thought that an 8-in. pitch is preferable, but was not available at the time of installation.

The conveyor is driven by a variable speed motor of 5-hp. capacity, which, however, is underloaded; a 3-hp. motor would be more suitable. It is belted to sprocket and chain speed reduction train, this being located at the top of the ascending side as indicated in Fig. 6. The speed of the motor is controlled automatically through a rheostat, in harmony with the steam pressure by means of a Ruggles double acting damper regulator which also operates the individual dampers of the boilers, distribution of the load being effected by hand adjustment of each damper rod length, where attached to the arms on the shaft controlled by the regulator.

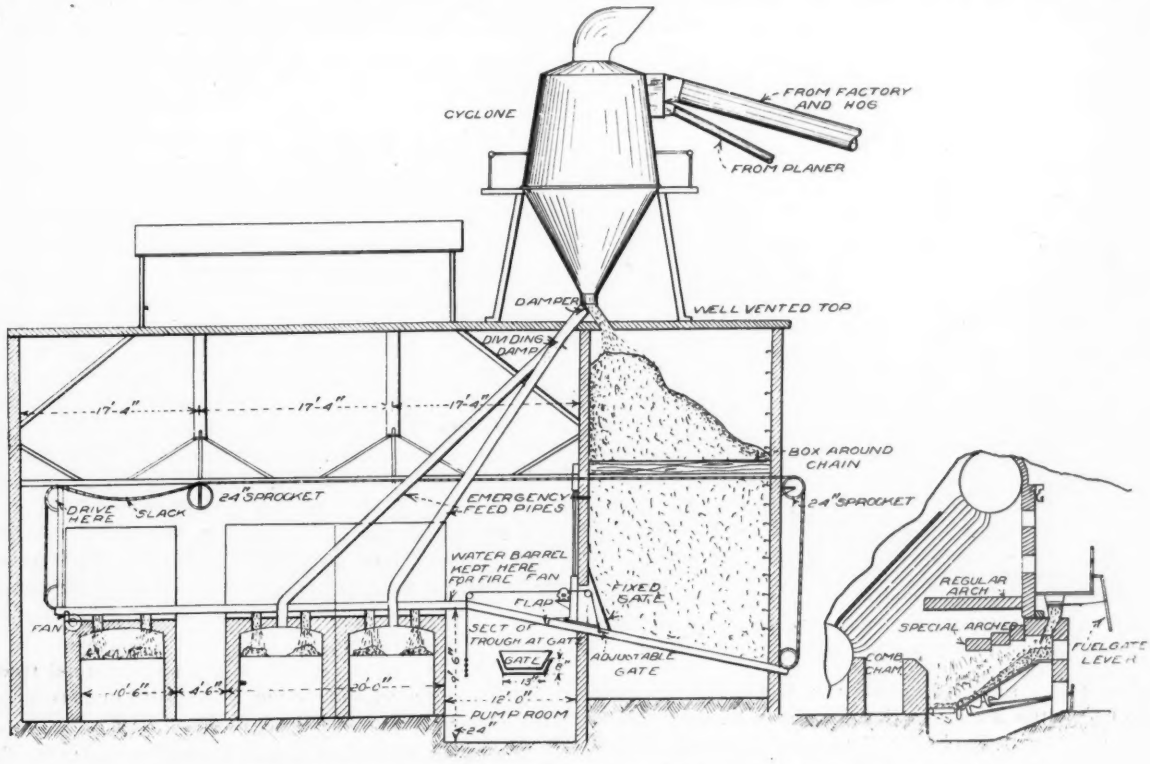


FIG. 6. SCHEME OF SAWDUST HANDLING SYSTEM EMPLOYED AT CURTIS BROS. & CO.'S PLANT

On the slack side of the driving sprocket is a short space where the chain is allowed to sag between two sprockets, due to its own weight, thus taking up all unavoidable slack in the chain. Beyond this space in the upper run, the chain is carried on 2½-in. angle irons to the storage bin, through which it passes through a box which holds the sawdust away from the chain. The descending side of the chain is entirely outside the bin, giving an opportunity to maintain the bearings in good condition.

The lower run of the chain is carried in a trough made of No. 10 gage black sheet iron formed in the company's own hydraulic press in pieces of 8 ft. length.

The width of the trough at bottom is 13 in. and the depth 8 in., the sides diverge slightly from the bottom to the top. At the point where the chain leaves the bin is a fixed gate placed at an angle with the wall, the lower end being about 12 in. above the chain. Behind this gate is another which is adjustable to suit the load conditions. In front of the adjustable gate, the shavings have a tendency to pack; this is relieved by providing an open space over the gate permitting packed shaving to spill over the top and back into the trough. The height of this gate, which is pivoted some 3 ft. back from the face, is adjusted by means of a chain running over pulleys, as indicated, a telescoping pipe and clamp arrangement being used to hold the gate in position.

One of the greatest difficulties encountered in operation is that of shavings bridging over the chain, thus preventing proper feeding of the fuel. Several devices for agitating the shavings have been used, but with little success. It is now the practice, when bridging occurs, to poke the bin at the lower end through the inclined

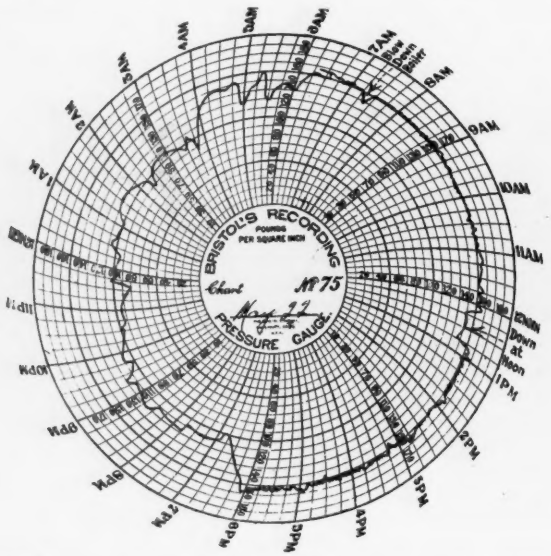


FIG. 7. TYPICAL STEAM PRESSURE RECORD FROM SAWDUST FIRED BOILER

bottom where separate boards are fitted in slides used for closing the opening. Shavings may require poking once or twice daily, but if the chain is not allowed to stop, little trouble with bridging is encountered. Continuous movement of the chain is obtained through use of the regulator control.

Furnaces for Sawdust or Coal

At each of the furnaces are two feed spouts to distribute the shavings on the grate. The slide gates to these open from alternate sides, thus giving the chain a chance to clear itself of shavings; this process is aided, however, by spring fingers placed over the spout gates. What shavings still cling to the chain are removed at the end of the lower run where a suction fan collects them but does not discharge them back to the bin, because of the fire hazard of such practice. Another fan is located at the other end of the conveyor to catch dust coming through openings in the wall above the chain, this discharges to the bin.

The furnaces are equipped with National hand stokers, but only about half the area is needed under normal conditions, the remainder must be kept covered with ash. The shavings are seldom more than 12 in. deep at any point on the grate. Practically all air must come through the grate as the furnaces are operated with closed firing doors and the draft ranges from 0.15 to 0.2 in. of water as indicated by an Ellison draft gage on each furnace. The stack is of sheet iron 138 ft. high by 6 ft. diameter.

The plant has three 200-hp. Stirling boilers which are operated at 165 lb. pressure, and the success of the furnaces may well be judged from the record of the steam pressure gage reproduced herewith. The uniform feed has practically eliminated priming of the boilers, a difficulty previously encountered. Coal also may be fed by this same chain conveyor on the inclined style of grates.

Coal is used only at night and when the supply of shavings is not sufficient to develop the required amount of steam. Nevertheless, a convenient system for coal handling has been provided and an emergency storage bin was built recently to care for immediate deliveries. This bin has a capacity of approximately 450 t. and being necessarily located with one end next the railway track, some means to mow the coal was necessary.

Figure 8 illustrates the conveying device designed and built on the premises for this purpose. It consists of a trough of No. 10 gage sheet steel formed by pressing between two I-beams, one a size larger than the other, in a hydraulic press. The trough is made up of 8-ft. lengths riveted together and braced with angle irons. An ordinary transmission chain to which blocks are attached at convenient distances scrapes the coal in the trough from the V-shaped hopper at the track to the point of delivery. A 3-hp. motor drives the chain, which at first gave some trouble due to coal getting into the links and forcing the chain off the sprocket. This was overcome by placing a 2 by 4 lengthwise in the trough which scraped these lumps off the chain. The cost of this conveyor was $150, exclusive of the motor, and it will handle all that two men can shovel delivering to any part of the bin.

On the floor of the storage bin is an industrial track on which coal is wheeled to the boiler room in convenient hand-pushed cars.

The steam developed is used to furnish power for the factory, the electric generating units consisting of a 22 by 32-in. Nordberg poppet valve engine direct connected to a three-phase General Electric Co. generator of 575 kv.a. capacity run at 150 r.p.m., and 14 by 16-in. Ball engine connected to a 125-kw. G. E. generator run at 276 r.p.m.

Provision for the use of outside current is made, and during the summer months the boilers will be shut down during nights and outside power used to drive pumps.

An indirect system of heating is employed for the factory, exhaust steam being used supplemented by live steam during severely cold weather. The heating conditions here are peculiar, inasmuch as the fans used for collecting the dust and shavings draw 40,000 cu. ft. a min. from the building. This loss of air is made up by delivering to the factory 60,000 cu. ft. of hot air a

minute by a fan driven by a two-speed motor, the half speed being used at night when the machinery is not running. Air is then recirculated up one duct on one side of the building and down on the other. During working hours, hot air is discharged through both duct systems.

Firebrick Furnace for Mixed Fuel

At the spring meeting of the American Society of Mechanical Engineers, Robert H. Kuss expressed the opinion that kiln-dried wood refuse when burned alone constitutes no particularly difficult problem. If a sizable proportion is sawdust or planer shavings, this material must be burned in a complete firebrick furnace, the fuel being introduced by gravity and most of it being burned in suspension with very little air from the ashpit. Where coal and wood refuse are burned together, difficulty is encountered if the major portion of the fuel is sawdust. The complete firebrick furnace is in his opinion essential where a mixture of fuel contains sawdust.

Albert A. Cary called attention to the fact that fully half the weight of wood fuel is found in the volatile gases passing off during the process of combustion. With properly designed furnaces the greater part of the air required for the combustion of these gases can be made to pass through the grates and fuel bed, where they will become warmed to such an extent that they will not suppress the combustion of the gaseous portion of the fuel in the combustion chamber. An ample and well-designed combustion chamber is also essential. In a properly designed furnace wood may be burned without smoke and cinder screens enclosing the top of the chimney eliminate the danger of flying fire brands.

Pulp-wood chips or shavings containing as much as 30 to 40 per cent of moisture have been burned in a reverberatory furnace with a heavy bed of burning fuel maintained to dry the moist wood rapidly as it is fed continuously into the furnace.

Furnace for Wood Burning

In burning forest wood such as trunks, boughs and branches, best results were obtained with a wide furnace in which wood is charged lengthwise through a front opening. With a long furnace it is difficult to maintain a good level fuel bed and have the grates evenly covered. A furnace 5 ft. wide by 7 ft. deep gave best results. The charging door ran across the width of the furnace and about 12 in. high, it lifted vertically above the dead plate along the outer face of the front wall and was counterweighted and perforated with ½-in. holes.

The cut lumber was piled in front of the door so that it lay lengthwise, running from one side wall to the other. When the door was lifted the lumber, thus arranged, was pushed over the dead plate onto a grid of sloping grate bars dropping downward at an angle of 30 deg. At the lower end of these sloping grates and about 18 in. from the bridge wall was arranged another grid of sloping bars dropping down from the bridge wall at an angle of 45 deg., thus forming a V-shaped grate surface having a long and short leg.

FIG. 8. EMERGENCY COAL STORAGE BIN

Furnace Dimensions

In a recent issue of Industrial Management, C. T. Baker gives the following dimensions for wood burning boiler furnaces: For return-tubular boilers the shell should be located at least 48 in. and preferably 58 to 60 in. above the grates. For water-tube boilers, a distance of 6 to 8 ft. from the grates to the bottom row of tubes will give good results.

Bridge walls should not be built closer than 14 in. to the shell, in the case of return-tubular boilers, and often 16 in. is better. With water-tube boilers, the bridge wall construction is more or less dependent on the make of boilers and whether or not vertical or horizontal baffling is used.

Draft Gage an Essential

One of the greatest problems in burning wood, according to Mr. Baker, is to keep down the loss due to excess air, as it must be remembered that wood does not

lie as closely or "pack" on the grates as does coal. As the chances for air in excess quantities passing up through the fuel bed from beneath the grates are much better than where coal is burned, the stack damper must be used intelligently, and as a proper guide for draft control a draft gage is essential.

If sawdust is available and can be secured at a nominal cost, its use in connection with wood will be found advantageous, as it will enable the fireman to keep the grates more uniformly covered, thereby reducing the excess air losses above referred to, and at the same time effect a further saving of wood due to the heat value of the sawdust. Regular sawdust grates can be used to advantage where wood and sawdust are burned together continuously.

Relative Heat Values

Ordinarily, a cord of well seasoned pine wood will equal a ton of coal, having a heat value of say 12,500 to 13,500 B.t.u. per pound. In this connection a saving of 12 to 15 per cent can be effected by buying wood in excess of the requirements and allowing it to season before using, instead of burning the green wood as it is delivered from the forest.

Wood is usually delivered in four-foot lengths, hence it is possible to brick off some of the grate area next to the bridge wall in long furnaces with good results, as furnaces over 6 ft. in length present some difficulty in keeping the grates covered, resulting in excess air losses.

Use Thermometer in Uptake

Some wood, particularly certain pine wood, when burning, leaves a heavy deposit of soot on the heating surfaces; consequently, arrangements should be provided for properly blowing the heating surfaces with steam, otherwise there will be a decided dropping off in evaporation as the gummy soot is often a greater nonconductor of heat than coal soot. A thermometer or pyrometer in the flue gas uptake gives a check against dirty heating surfaces.

Firing Crude Oil

Types of Burners, Furnaces and Methods of Regulation. By J. W. Eshnaur

At the present time, owing to the increased cost of coal, there is a tendency toward a more general use of crude oil as a boiler fuel, and a few words by one who has had an extended experience with it may not come amiss.

The burning of oil presents a number of problems and requires some study and attention on the part of the engineer who would secure the best results with it.

Out here in California, nearly all steam plants are oil fired and, like all other branches of our trade, there are new methods and appliances being introduced all the time; nevertheless, the general principles remain the same. Given proper furnace construction, good draft and the right kind of a burner, there should be little trouble in handling oil.

I have tried a number of different forms of furnaces during the last 18 yr. and, taking the return tubular boiler as an example, I find the form shown in Fig. 1 to give the best results for general all-around service. Beginning at the front wall of the furnace and extending a distance of 4 to 6 ft. toward the rear, level with the dead-plate, there should be a floor of fire brick, arranged checkerboard fashion, laid on iron bars, pipes or other suitable supports. This breaks the air up into small currents and brings it up underneath the flame. From the end of this floor to the rear wall the furnace should be filled up with broken fire brick, concrete, sand or any material of like nature, sloping gradually upward. The space between the bottom of the boiler and the floor at the rear end being 18 to 24 in., according to the size if the boiler. The burner should be set just above the dead-plate and should not extend more than 2 or 3 in. inside the furnace wall. I have used this arrangement in two different plants and secured the best results from it.

For water-tube boilers the furnace construction is essentially the same as for coal, excepting that the grate bars are removed and the burner is introduced through the top of the ash-pit doors. It is quite usual to employ two or more burners under boilers of the Stirling type on account of the wide heating surface.

There are a number of burners on the market, divided into two general classes; inside and outside mixers. In the inside mix burner the oil and steam are led by separate pipes to a chamber in the body of the burner, as shown in Fig. 2, where they mix and are blown out into the furnace through a slot which is sometimes of variable width. In the outside mix burner, the head has two slots through which the steam and oil are discharged independently. The lower slot allows the steam to escape in a fan-shaped spray and the oil issuing from the upper slot falls on this and is thoroughly atomized. This type is shown in Fig. 3.

Of the other two kinds, I prefer the outside mix burner. I have used it under return tubular, water-tube and locomotive boilers and in nearly every case have secured much better results than with the other type; although there are undoubtedly some conditions where the inside mix burner is better adapted for the work. Broadly speaking, I have found the inside mix burner best for a large, heavy fire and the outside mix best for a medium or light fire.

In most cases the oil is fed to the burner under pressure; but some few plants still retain the gravity system, where the oil tank is situated at a suitable height above the burners and the oil allowed to flow to them by gravity. In the pressure system the oil is pumped from the storage tank, which is usually placed underground, by a small pump and fed to the burners at pressures ranging from 20 to 70 lb., depending on the type of burner and regulator. The pump set consists of a stand on which are mounted two small duplex pumps, generally about 3 by 2 by 3, connected so that they may be used independently or both together, though this is seldom necessary.

On the steam line is a diaphragm governor, controlled by the oil pressure. Underneath the stand is a small heater, consisting of a coil in a shell. The exhaust steam from the pumps is led through the coil and the oil goes through the shell on its way to the burners. There is a bypass from the discharge to the suction, equipped with a pressure relief valve set about 5 lb. above working pressure. With inside mix burners the pressure carried is from 40 to 65 lb. and with outside mix 20 to 40 lb.

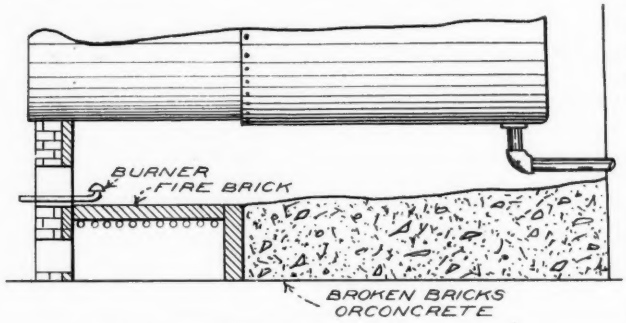


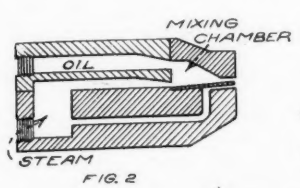
FIG. 1. SUCCESSFUL OIL BURNING FURNACE

These compact little pump sets maintain a constant oil pressure and give it a uniform temperature, occupy small space and require little attention.

The burner regulators are simply diaphragm governors, one on the oil and one on the steam line leading to the burner. The diaphragm side is connected to the steam space of the boiler, preferably independent of all other lines, and when properly adjusted they will hold any desired pressure on the boiler. A very small variation in the boiler pressure actuates the diaphragm valves and these in turn regulate the amount of steam and oil delivered to the burners. With a steady or nearly steady load, they will maintain a constant pressure on the boiler. With heavy fluctuations in the load, the variation rarely exceeds 5 lb.

California oil runs about 14 to 16 deg. gravity, 240 deg. flash, open test, and contains 16,000 to 18,500 B.t.u. per lb. The present average price is $1.85 per barrel. About three barrels will equal one ton of average coal.

Aside from gas, crude oil is the best and cleanest fuel to be had. There is no smoke, clinkers, cinders, ashes or



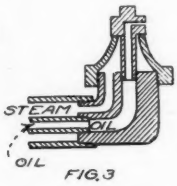


FIG. 2. SECTION OF INSIDE MIX OIL BURNER
FIG. 3. OIL BURNER EMPLOYING OUTSIDE MIXING

dust and very little soot. It is easily handled and readily adapted to any and all changes of load, and when the day's run is over the fire can be put out, thus saving the expense of banked fires.

In the regulation of the fire, either manually or automatically, there should be just enough steam to atomize the oil properly. The body of the flame should be nearly white, with the tips a decided orange. If there is not enough steam, the flame will be red and the fire will smoke. Too much steam makes a dazzling white fire and, especially with the inside mix burner, will make the fire jump and roar. Too much draft will do the same thing and too little draft will make a red, smoky fire. It should be remembered that in no case should the flames be allowed to impinge on the sheets, but should flow along underneath the bottom of the boiler. Proper placing of the burner and careful regulation of the draft will take care of this. Taken all around, considering its cleanness, economy and general ease of handling, crude oil is one of the best boiler fuels on the market.

Mechanics Wanted by the Air Department

HIGHLY SKILLED mechanics are needed in the Aviation Service, and will be given intensive training preliminary to assignment to fighting, repair or construction squadrons. Each squadron consists of 150 men, the majority of whom are non-commissioned officers, though all are enlisted as privates and are promoted as their proficiency is proved.

Men not in the draft may enlist, and those subject to draft may be requisitioned from their draft board and be, at once, inducted into the air service.

Trades for which men are being accepted are as follows: Mechanician, who must have studied algebra and geometry and have had experience in some branch of the manual arts, though not necessarily as a skilled mechanic. Fabric worker, who must have knowledge of fabrics and some practical ability as a tailor, sailmaker or tentmaker. Engineman, who must have some knowledge of the construction and operation of automobile engines, and have been engaged commercially in repair and overhauling of automobile engines. Also cabinet makers, carpenters, electricians, vulcanizers, welders, blacksmiths, toolmakers, sheet metal workers, who must have been engaged in those trades as craftsmen for at least a year.

Men possessing these qualifications, even if not able to pass for service in the firing line, can render a distinct military service by applying for acceptance. Application should be sent to the office of the Director of Military Aeronautics, Washington, D. C., or for the Chicago district to Major O. Yarnell, 230 East Ohio St., Chicago, Ill.

THE U. S. CIVIL SERVICE COMMISSION announces an open competitive examination, Aug. 27, 1918, for assistant sanitary engineer, to fill vacancies in the public health service or other branches of the service requiring similar qualifications, at $1600 a year, or higher or lower entrance salaries. Competitors will be rated on physical ability, education, training and experience. Apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.

DO NOT FORGET that War Savings Stamps are not for children only. Most of the squandering is done by the grown-ups.

Improving Factory Steam Plants---II

INCREASED CAPACITY WITH A MINIMUM EXPENDITURE. BY H. A. WILCOX

THOSE interested have without doubt recognized experiences similar to those outlined in the introduction to this series of articles, and we will therefore plunge at once into a short description of the factory plant to be discussed in this article.

This case was somewhat similar to that described in case one, inasmuch as the product was the same. My only reason for touching upon it is that the equipment and treatment were vastly different in the two cases.

The manufacturing machinery was practically the same in both plants, only that in case two was of about five times the capacity of that in case one. A brief history will not be out of place at this point, as it tends to show up the chief bugbear in factory power plants of today, as mentioned in the introduction to case one.

The plant was and is today a "war bride," being devoted exclusively to the bleaching of cotton linters for guncotton. It was the starting point of a small chain of plants which were hastily erected at the beginning of the present war. The entire plant was erected, buildings and all, in a very short time, as speed then, as now, was synonymous with profits. It was originally designed to produce about 300,000 lb. of bleached cotton linters per week.

The plant was driven throughout by electricity and the only steam used was for boiling, drying and heating, except that at the outset a small second-hand slide-valve engine was installed for driving a ventilating fan. As there was no use for the exhaust steam of the engine and the engine was in poor condition, anyway, it was shortly removed and electric drive substituted.

The original boiler plant consisted of five Manning type vertical boilers. Reader will please note the words "Manning type," as we shall have occasion to refer to this later on. There were no O-gee rings, which is a familiar detail of the true Manning boilers. These boilers were rated at 228 hp., based on 10 sq. ft. of heating surface per horsepower. The boilers were fed by a turbine driven centrifugal feed pump which drew from a receiving tank located so that there was always a head of at least 7 ft. on the pump suction. The returns going into this tank came from the exhaust of an engine driven derrick; the exhaust from the fan engine previously mentioned, each having oil separators; the returns from the steam heating system; the traps from the heating coils on six driers (each drier contained about 11,000 linear feet of 1¼-in. pipe); and from traps which drained the main steam lines at different points. The feed pump discharged through a closed coil feed-water heater, through feed-water regulators, into the boilers. About 7 lb. live steam pressure was maintained on the closed heater by means of a reducing valve. Makeup water of the receiver was automatically admitted by a chronometer valve and an overflow was provided on the receiver. The feed water to the boilers was measured by a Venturi meter. With the above combination a feed water temperature of from 210 to 230 deg. F. was constantly maintained.

Soft coal, having an average heat content of from 13,000 to 14,000 B.t.u. was burned. This coal was wheeled into the boiler room in wheelbarrows and dumped in a pile on the floor in front of the boilers. Every wheelbarrow of coal was weighed and a record of the amount of coal and feed water used on each shift was kept. I have neglected to state that this plant was run at top speed for 24 hr. a day every day in the year.

As mentioned at the beginning, the plant was designed for a weekly output of 300,000 lb. of bleached linters. When I was called in, I believe that the production had risen to about 500,000 lb. per week and trouble was being experienced in maintaining the desired steam pressure of 120 lb. A further increase in production was being contemplated and an additional boiler of the same type and of 200 hp. had been ordered.

My first step, on taking charge, was to familiarize myself thoroughly with all steam producing and steam consuming apparatus. The main steam consuming machines were the six driers and about a dozen kiers.

		Boilers 1-5	Boiler 6	Total for 6 Boilers
(1)	Diameter of shell	64 In.	64 In.	
(2)	Size of tubes	2½ In. by 15 Ft.	2½ In. by 15 Ft.	
(3)	Number of tubes per boiler	356	308	2068
(4)	Total heating surface per boiler	3285 Sq. Ft.	2785 Sq. Ft.	19,010 Sq. Ft.
(5)	Furnace heating surface per boiler	115 Sq. Ft.	115 Sq. Ft.	690 Sq. Ft.
(6)	Total tube heating surface per boiler	3140 Sq. Ft.	2620 Sq. Ft.	18,320 Sq. Ft.
(7)	Superheating surface of tubes	837 Sq. Ft.		
(8)	Grate surface per boiler	33 Sq. Ft.	33 Sq. Ft.	199 Sq. Ft.
(9)	Nominal boiler horsepower per boiler	†228	*200	1340
(10)	Sq. Ft. heating surface / Sq. Ft. grate surface	97.5 & 26		
(11)	Sq. Ft. grate surface / Rated boiler horsepower	0.14	0.165	
(12)	Sq. Ft. heating surface / Rated boiler horsepower	**11.6		

Data on Operation of all Six Boilers

(13)	Average draft over fire (inches of water)	0.15 In.
(14)	Average draft breeching (inches of water)	0.35 In. to 0.38 In.
(15)	Average feed water per hour	36,600 Lb.
(16)	Average actual evaporation	10.3 lb. water per pound coal
(17)	Av. pounds of coal burned per square foot of grate per hour	16 Lb.
(18)	Av. pounds of coal burned per rated boiler horsepower per hour	2.7 Lb.
(19)	Av. boiler horsepower developed per hour from six boilers	1061 Hp.
(20)	Pounds of coal burned per actual horsepower-hour developed	3.4 Lb.

*Approximate. **Not including superheating surface.

† Based on 11.6 Sq. Ft. heating surface per boiler horsepower, excluding superheating surface.

†† 75 actual heating surface and 25 superheating surface

DATA RELATIVE TO BOILER PLANT

The kiers used live steam cut down by a reducing valve to 75 lb. pressure and the driers used live steam at 120 lb. pressure (when the boilers could furnish it). The contract for the output specified 75 lb. live steam for boiling the kiers and previous experiment had proved to me that exhaust steam could not be used successfully on the driers. The fan engine was too small to furnish enough exhaust steam for heating the plant or even the feed water. Moreover, as the engine was second-hand and in bad shape, its repair bills were too high to permit of its being run economically. Therefore, at the first opportunity an electric motor was substituted for the engine.

It was next noticed that the vent on heater was constantly allowing large quantities of steam to escape to the atmosphere, and that the overflow from the receiver (a 6-in. pipe) was in operation most of the time, allowing the escape of a great deal of hot water. Examination speedily

demonstrated that the drier traps were blowing by and that the float on the chronometer valve leaked, keeping the valve open all the time and filling the receiver to the overflow pipe. To cure these troubles, a new float was installed on the chronometer valve and the discharge from the valve was fixed so that a constant spray of cold water fell down from the top of the receiver on the inside in order to condense any steam which might be given off by the returns. In addition, the traps on the driers were overhauled and placed in proper working order and a "tickler," or reminder, was started, to come out every three months, to have these traps overhauled. A spare trap was kept on hand to be used in place of the regular one as each one was overhauled and repaired.

Being satisfied that all the hot returns were now being brought back, through the feed pumps, to the boilers, attention was next directed to the boiler room.

An examination of past records of coal, water, feed water temperature, etc., gave me a decided surprise. I found that an actual evaporation of between 10 and 11 lb. of water per pound of coal was being averaged. Being somewhat suspicious of these figures, I ran a few tests of my own and found that in all probability the figures were quite accurate.

I then started in to make a close study of the operation of the boiler plant, keeping records of all that occurred and the time, nature and duration of all drops in steam pressure.

In a short time my records indicated that a steam pressure of from 90 to 100 lb. could easily be maintained provided the fires were all in good clean condition, but that cleaning a fire under one boiler meant a drop to 60 lb. and the shutting down of part of the plant in order to get back to 100 lb. again. Sudden drops were noticed from time to time, which caused a loss in pressure of from 10 to 20 lb. in a very short time. Then the pressure would come back again gradually without shutting any part of the plant down. These sudden drops were caused by the quick opening of a 2-in. valve in order to boil a kier (a cylindrical revolving vessel about 40 ft. long and 10 ft. in diameter). As soon as the kier came to a boil, very little steam was required to keep it in that condition. Then again, two or three kiers were sometimes opened up at once. To cure this trouble, orders were issued that steam was not to be turned on in more than one kier in 1½ hr. and that the valve must be opened slowly so that the kier would not come to a boil within half an hour after it was started. In addition, it was found that, in an effort to bring the kier to a quick boil and so obtain greater production, the kier men hung on the weighted arms of the reducing valve supplying the kiers when first starting up. This allowed full boiler pressure on the line. This was overcome by enclosing the entire reducing valve, except the gage, in a sheet iron box which was kept locked.

Inquiry developed the fact that the boilers were washed and the tubes cleaned at irregular intervals, such as on holidays or when a breakdown in the manufacturing end caused a partial shutdown in the plant.

I insisted that a partial shutdown be made every Sunday morning for 6 hr. in order to afford us an opportunity for washing and cleaning two boilers. In this way, we could care for each boiler every three weeks. This was a very short time for this work, but was the greatest concession I could obtain.

About this time the new boiler arrived and was installed and this afforded temporary relief. The production of the plant was increased at once and our troubles soon came back with added vigor.

One day all the boilers began to foam badly. They were blown down a little, but this did not cure the trouble. Examination of the feed water indicated the presence of caustic. Two traps, which drained the steam line to the kiers, were discharging quite a little caustic into the receivers. These trap lines were removed from the line to the receiver and no more trouble was experienced from this source. For a long time a delicate chemical test was made on a sample of feed water each morning to determine whether there was caustic in the water or not.

In the meantime, our weekly cleanings had indicated the presence of a very hard scale on the tubes of the boilers. This was particularly noticeable at the joints where the tubes entered the fire or crown sheet, where a thick fillet was formed. This fillet kept the water away from the tube end which, as a consequence, became red hot and the pressure forced it away from the crown sheet and thus developed a leak. The tubes were so close together that scraping was of no avail and various compounds were tried with little or no success. This condition grew so bad that whenever a boiler was let down for cleaning, nearly all the tubes had to be rolled in the fire sheet. This repeated rolling thinned the tube ends to such an extent that their holding power on the crown sheet was greatly lessened. I looked into more than one firebox at this time and, even with a big fire going, there appeared to be a regular rainstorm coming from the fire side of the crown sheet. The only way to cure the evil completely was to re-tube the boilers. These boilers were second-hand in the beginning (on account of obtaining quick delivery) and had been run continuously for over 2 yr.

Orders were issued to re-tube five of the boilers. One complete set (356) of charcoal iron tubes was purchased. A boiler was let down; the old tubes removed, and the new set installed, the plant being partially shut down to allow this. As fast as the old tubes were removed, they were sent to a boiler shop. There they were thoroughly rattled and safe-ended. That is, all scale was removed, each end cut off from each tube at a point about 6 in. from the end, and new ends were welded on. By the time a new set of tubes had been placed in the first boiler, a set of safe-ended tubes had come back for use in the next boiler. The old tubes from the second were safe-ended for the third and so on. In this way, delays and expense were minimized. New tubes at that time cost 48 cents per foot. The reader may well imagine that we hustled some when it is stated that just about 72 hr. elapsed from the time a boiler was let down until it had been re-tubed and was in operation again. In fact, the old tubes could not be safe-ended fast enough and toward the end we had to wait after re-tubing one boiler before we tackled the next in order that there might be no delay in waiting for tubes. About 100 tubes were spoiled in safe-ending and new tubes had to be bought in their place. In all, 1780 tubes were taken out and replaced. The tubes were each 15 ft. long and at 48 cents per linear foot, cost new

$7.20 apiece. It cost $1.25 per tube for safe-ending. It will therefore be noted that a very large saving was effected by safe-ending the old tubes. Each boiler was tested at a cold water pressure of 140 lb. before being placed in operation, after re-tubing, and the Boiler Insurance Co. approved of the safe-ended tubes in every way, as the work was done by a responsible firm, having long experience in this line of work. A further argument for using the old tubes safe-ended was the fact that at that particular time it was almost impossible to obtain so large a number of new tubes at any price, except at six months' delivery. The boilers would not have lasted as long as that and new boilers were unobtainable at any price, except at about 2 yr. delivery, besides the installation of new boilers would have required a much longer shutdown.

After the re-tubing was completed, the proper compound was selected and was fed at regular intervals and in proper proportions. With good, clean boilers, etc., things went along very smoothly and we thought that our troubles were ended.

A brief digression may be permitted here. The reader will remember that I emphasized the words "Manning type" at the beginning of this article. It would seem, from our experience, that Manning boilers were prone to very serious troubles. In order to right this impression, I will state that these boilers differed in many respects from the true Manning, such as height of crown sheet and grates, etc. Since my connection with these boilers, I have made many inquiries of users of Manning boilers and I find that on the average they were very well satisfied with their performance and I have therefore come to the conclusion that our troubles were largely due to lack of proper care and a few points of bad design which do not appear in the Manning boiler. On one of these points, the reader will soon be able to judge for himself.

After about two months of freedom from trouble, the old bugbear, low steam pressure appeared. An increase in manufacturing capacity had been made and the production jumped to 1,200,000 lb. per week. *No increase had been made in the boiler plant capacity.*

At this time, I determined to fix things so as to provide, if possible, for all future increase of production and "then some" if I could.

A very exhaustive analysis of the situation was made and records covering the operation of the plant since its beginning were carefully studied. A report with recommendations was made to the manager and chief engineer, the result of which will be given later on.

(To be continued.)

A National Trade-Mark

MOVEMENT is under way to establish a National Trade-Mark for goods made in the U. S. A., and a bill is before Congress to regulate licensing of firms which are permitted to use it.

Some opposition has developed on the part of leading exporters who have established their own trade-marks in foreign markets on the ground that this will give competitors an advantage they have not earned.

The Department of Commerce calls attention to the advantages, even to those firms that have established foreign trade, from a recognized, government-controlled National Trade-Mark.

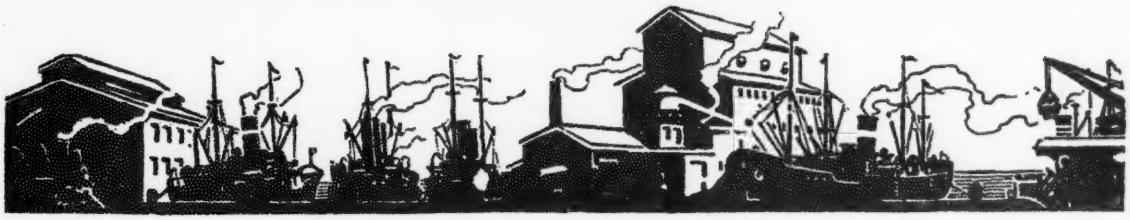
Such a designation will help to create good will in foreign markets, to increase credit and popularity of American-made goods, and will better banking and transportation facilities. Only honest merchandizers will be licensed, hence the National Trade-Mark will come to stand for quality and fair dealing.

While this will help all exporters, it will not enable a manufacturer to sell his goods until he has established a selling organization and solved the problems of credits, transportation, packing, correspondence, etc., in all of which the established house has an advantage. If he works out all these problems and finds a foreign market either new or in foreign competition the new exporter is entitled to the business.

The use of the National Trade-Mark will be protected by a bond of $5000 from each licensee, subject to forfeiture if government regulations are not observed. This cannot be done in the case of the "Made in U. S. A." mark now used, hence the establishment of the National Trade-Mark will help to strengthen the reputation of goods of American origin, thus benefiting all exporters.

OWING TO the enormous increase of government war work, the governmental departments at Washington are being flooded with letters of inquiry on every conceivable subject concerning the war, and it has been found a physical impossibility for the clerks, though they number an army in themselves, to give many of these letters proper attention and reply. There is published daily at Washington, under authority of and by direction of the President, a government newspaper—The Official U. S. Bulletin. This newspaper prints every day all the more important rulings, decisions, regulations, proclamations, orders, etc., as they are promulgated by the several departments and the many special committees and agencies now in operation at the National Capital. This official journal is posted daily in every postoffice in the United States, more than 55,000 in number, and may also be found on file at all libraries, boards of trade and chambers of commerce, the offices of mayors, governors and other federal officials. By consulting these files, most questions will be found readily answered; there will be little necessity for letter writing; the unnecessary congestion of the mails will appreciably be relieved; the railroads will be called upon to move fewer correspondence sacks, and the mass of business that is piling up in the government departments will be eased considerably. Hundreds of clerks, now answering correspondence, will be enabled to give their time to essentially important work, and a fundamentally patriotic service will have been performed by the public.

APPROXIMATELY 50,000,000 car stops are made in the United States each day. The "skip-stop" schedule would eliminate one-third of these. The elimination of 6,000,000,000 stops a year, together with the regulation of car heating, will bring a fuel saving of not less than 1,500,000 tons of coal a year, which will meet the fuel needs of 300,000 average families.—COMPRESSED AIR MAGAZINE.



Blocking New Wars

A Court House for the World. The Sword to Enforce Peace. By Herbert S. Houston, Member of the Chamber of Commerce of the U. S. A., on Economic Results of the War*

IN every country in the world, if it is so much as half civilized, there is some form of court. And yet the world itself is without one. There is, to be sure, the Permanent Court of Arbitration, agreed to at The Hague Conference of 1899, but that is a piece of judicial machinery, in form, without any force to give it effectiveness. And the utter futility of this court either to stop or delay war was demonstrated so completely in 1914 that it doesn't seem possible that the world will care to have another demonstration. It is inconceivable that a league of nations should establish a court and permit it to be a mere shadow without any power to give it substance. Too much blood has been shed and debts too stupendous piled up for future generations to pay, to allow a peace conference to decide on a court that would be but a hollow mockery. As a distinguished jurist of the Netherlands, M. Asser, said in The Hague Conference of 1907, in speaking of the Permanent Court of Arbitration, "Instead of a Permanent Court the Convention of 1899 gave only the phantom of a court, an impalpable spectre, or, to speak more precisely, it gave a secretarial and a list. And when two powers having a difference to settle demand that the doors at The Hague be opened to them, the secretary-general, thanks to the munificence of Mr. Carnegie, can show them a splendid hall, but instead of a court he can only present to them a list on which they may find a large number of persons of a recognized competence, etc."

The Supreme Court of Arbitral Justice, which engaged so much of the attention of the Second Hague Conference in 1907, was not agreed upon, but if it had been, there is small ground to believe that it would have been more than a "phantom of a court," for no provision was made that hearings before it should be enforced. And the World Court, proposed and supported by a considerable group in this country, had the same inherent weakness, which undoubtedly explained its failure to obtain any broad popular endorsement either in the United States or in Europe.

Fully realizing the fatal weakness in these plans for international courts, the League to Enforce Peace made economic and military force the sanction that should compel signatory nations to present their differences for hearing. And from the moment the league was organized in Independence Hall, Philadelphia, on June 17, 1915, it has steadily gained support for its program. The reason is manifest. In a world at war the doctrine was proclaimed that peace when it came could only be maintained if it rested on ultimate force. Instead of beating swords into ploughshares it was proposed, in effect, that they be kept in their scabbards ready to be drawn in defense of law. This seemed strangely like a paraphrase from the Bible in grounding belief in the bringing of peace *with* the sword. It was seen at once that this was not militarism, against which democratic nations have fought, but simply placing effective power behind courts so that they would be respected and used.

Such a sane and practical plan won support from the responsible statesmen of the world—from men charged with the leadership of their nations in the great war. Above the battle smoke they saw arise, courts, envisaging the reign of law, supported and enforced by economic and military power. "The best security for peace," said Mr. Lloyd George in January, 1917, "will be that nations band themselves together to punish the peace-breaker. In the armories of Europe every weapon will be a sword of justice. In the government of men every army will be the constabulary of peace." And M. Ribot in June, 1917, while the premier of France, said in an address before the Chamber of Deputies, "We echo the noble desire of the President of the United States. Henceforth justice must have as a guarantee the League of Nations which is organizing before our eyes, and which tomorrow will be mistress of the world." Mr. Asquith in an authorized statement in November, 1917, said, "We must aim at something more than the negative functions of policing the world and preventing breaches of the peace; at nothing less than a partnership of the nations in the joint pursuit of a freer and fuller life for the countless millions who, by their efforts and their sacrifices, generation after generation, maintain the progress and enrich the inheritance of humanity. Nor must our reconstruction concern Europe alone. We must aim at setting up a world-wide peace partnership, of which all the civilized communities will be members on a level footing, with equal rights and reciprocal duties."

In the United States ex-President Taft and hundreds of the leading public men of the country and thousands of important journals have supported the League of Nations program. The repeated endorsements from President Wilson have been read in all parts of the world. And it can be safely stated that the President has expressed the sentiment of his countrymen in all of these endorsements, of which the following is typical of many others: "So sincerely do we believe in these

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things, that I am sure I speak the mind and wish of the people of America, when I say that the United States is willing to become a partner in any feasible association formed in order to realize these objects, and to make them secure against violation. . . . I am sure the United States would wish their government to move along the line of . . . a universal association of nations to maintain inviolate the security of the highway of the seas for the common, unhindered use of all the nations of the world, and to prevent any war begun, either contrary to treaty covenants or without warning and full submission of the cause to the opinion of the world—a virtual guarantee of territorial integrity and political independence. . . . I feel confident that the world is even now upon the eve of a great consummation, when some common force will be brought into existence which shall safeguard right as the first and most fundamental interest of all peoples and all governments, when coercion shall be summoned not to the service of political ambition or selfish hostility, but to the service of common order, common justice, and common peace."

The court house for the world, in view of the innumerable expressions of strong support from statesmen of all the belligerent countries, including those of Germany and Austria-Hungary, seems to have been long in coming to nations in sore need of it. For war, that has been given up as a means in settling differences within nations, has continued as a final arbiter between nations. The world has groped blindly toward a sane internationalism that would gather up and use the tested experience from nations, without seeking to destroy them. It has depended too much on other international forces, failing to perceive the essential place and power of justice. But the world like every city and country needs a court house. That court is within our grasp. What is needed is to give it force through economic pressure and military power that will compel its use and it will become a bulwark of civilization, protecting the world from the waste and futility and the utter tragedy of war.

Sword to Enforce Peace

There were few illusions among the two hundred and fifty thoughtful people who gathered from nearly all parts of the United States, at Independence Hall in Philadelphia in June, 1915, to consider proposals and plans for lessening the dangers of war. For ten months the great war, steadily becoming greater, had been in progress. By general agreement, even more impressive because scarcely spoken, being in the minds of all present, the four proposals formulated for the program of the League to Enforce Peace, there organized, were for international adoption when the war was over. That agreement was interpretative of the sane and practical spirit which pervaded this short but historic conference. Not only was there no illusion about stopping the war already on, there was no illusion in regard to preventing future wars by the pacifist formula of optional arbitration or powerless courts. Of course the doctrine of nonresistance, even in a city whose hall of government bore the bronze effigy of William Penn, was not so much as mentioned. Instead of that, this great peace conference drew the sword, and in a noble preamble to its platform pointed to it as the final arbiter in any league of nations that might hope to supplant war by law in settling disputes between governments.

The founder of the University of Virginia, Thomas Jefferson, when he presented the Declaration of Independence in the same hall, one hundred and thirty-nine years before, had concluded it with the martial words of ultimate and complete sacrifice: "To this declaration we pledge our lives, our fortunes and our sacred honor." The president of Harvard University, A. Lawrence Lowell, placed in the forefront of the platform of the League to Enforce Peace, reported by the committee of which he was the chairman, words that implied the same supreme pledge: "Throughout five thousand years of recorded history peace, here and there established, has been kept, and its area has been widened, in one way only. Individuals have combined their efforts to suppress violence in the local community. Communities have cooperated to maintain the authoritative state and to preserve peace within its borders. States have formed leagues or confederations or have otherwise co-operated to establish peace among themselves. Always peace has been made and kept, when made and kept at all, by the superior power of superior numbers acting in unity for the common good. Mindful of this teaching of experience, we believe and solemnly urge that the time has come to devise and to create a working union of sovereign nations to establish peace among themselves and to guarantee it by all known and available sanctions at their command, to the end that civilization may be conserved, and the progress of mankind in comfort, enlightenment and happiness may continue."

Then followed these four short proposals:

"First: All justiciable questions arising between the signatory powers, not settled by negotiation, shall, subject to the limitations of treaties, be submitted to a judicial tribunal for hearing and judgment, both upon the merits and upon any issue as to its jurisdiction of the question.

"Second: All other questions arising between the signatories and not settled by negotiations, shall be submitted to a council of conciliation for hearing, consideration and recommendation.

"Third: The signatory powers shall jointly use forthwith both their economic and military forces against any one of their number that goes to war, or commits acts of hostility, against another of the signatories before any question arising shall be submitted as provided in the foregoing.

"Fourth: Conferences between the signatory powers shall be held from time to time to formulate and codify rules of international law, which, unless some signatory shall signify its dissent within a stated period, shall thereafter govern in the decisions of the judicial tribunal mentioned in Article One."

The distinguishing thing in these proposals, of course, and the thing which definitely separates them from the proposals of other peace organizations is the placing of force behind a world court, compelling it to be used. And why not? Surely the world, after the devastation and destruction of the present war, will come to the place where peace will seem so much to be desired that it is even worth fighting for. Many will say, this is war

itself, the very thing we seek to prevent. But let it be stated in rejoinder with overwhelming emphasis, that such a war, if it should be required as a last resort, would be war to enforce peace. It would be war to establish the integrity and authority of world courts that the nations had joined in setting up and had joined in agreeing to use. In a word such a war would be simply the use of power to enforce the due processes of international law and justice. If a court set up by the people is flouted, the state, through its constitutional officers and, if necessary, through its armed forces, asserts the sovereign power of the people and commands and compels respect for the court. That is not war—it is the state maintaining peace. So it is with the use of armed force to compel a recalcitrant nation to take its international differences to a court instead of to a battlefield. That would not be war but the exercise of military power to enforce peace. And it would frequently happen that the use of the great power of international commerce, applied as economic pressure, would be sufficient to sober a nation and bring it to the world court, without resort to military force.

Low-Pressure Turbine Drives Line Shaft

PECULIAR CONDITIONS IN PAPER MILL IDEAL FOR INSTALLATION OF LOW-PRESSURE TURBINE WITH DOUBLE REDUCTION GEAR

ELECTRIC motor drive, the simplest solution to additional power supply problems, is oftentimes not available to mill owners, whose plants are driven by line shafts. Often, however, there is sufficient boiler capacity in his plant to do the work, if it is effectively applied. Particularly where line shaft drive to a small number of machines is used. The installation of a turbine with speed-reducing gears is an ingenious solution to the problems.

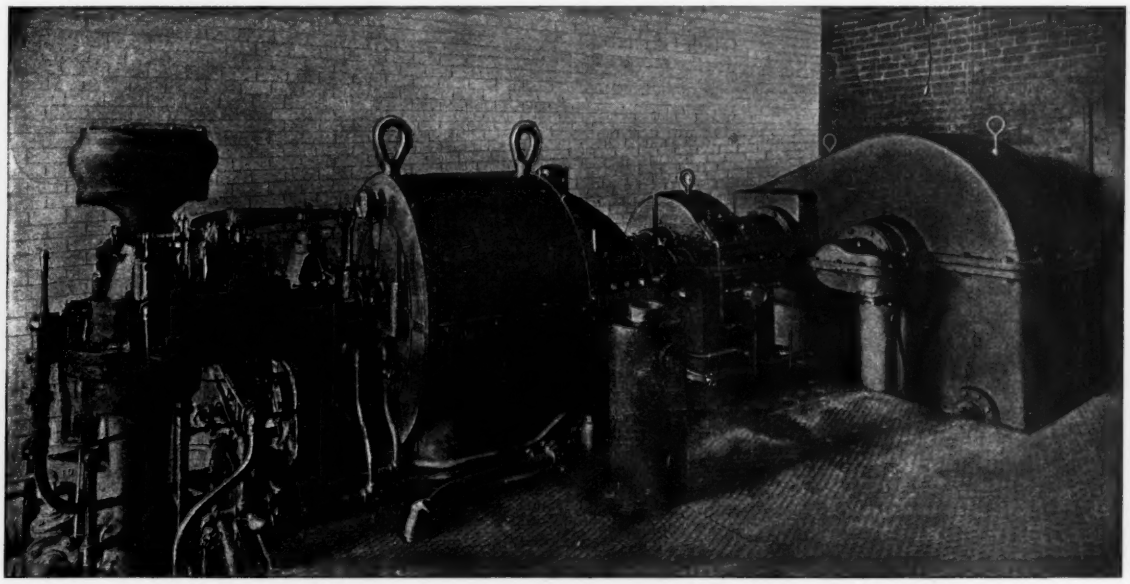


FIG. 1. VIEW OF TURBINE AND TWO REDUCTION GEARING

A unique line shaft drive, consisting of a Westinghouse low-pressure turbine and a Westinghouse double reduction gear has been installed in a Western Pennsylvania paper mill. There are two main line shafts to which the machines are belted. To one of the line shafts are belted two cutters, ten beaters and one Jordan; an identical equipment, with the exception of the cutters, is belted to the other shaft.

Only seven of the ten beaters, under ordinary running condition, are in operation at one time, and these with one Jordan, require about 600 hp. An additional 20 hp. is required for the rag cutters.

Heretofore, these two line shafts were each driven by a noncondensing reciprocating engine. However, one of these engines was wrecked and so necessitated the obtaining of a drive to replace it, at the least ultimate expense.

It is interesting to note the considerations entering into the final selection of the new drive. These conditions were somewhat as follows: Two 100-hp. noncondensing engines turned the rolls and gave practically all the exhaust steam necessary for feed water heating, so that all the exhaust steam from the 700-hp. noncondensing Corliss engine driving one of the line shafts, would have to be discharged to the atmosphere, unless some means were provided for abstracting the energy still available in it. A low-pressure turbine was the logical prime mover, without a doubt, but it would have been of little use, on account of its high speed, had there not been a reduction gear to receive the power generated and to deliver it to the line shaft at low speed.

Other types of drive were considered, but each had inherent characteristics which disqualified it. For instance, a duplication of the old reciprocating engine was stepping back into the old rut, with the inevitable wast-

ing of exhaust steam. A condensing engine would have been expensive, and no material improvement. Again, an electric motor, while comparatively cheap to install, would have been much more expensive, when the electric power bill was added to the cost of energy lost in wasted exhaust steam. And finally, it was still more expensive to install a turbine generator and an individual electric drive, because the existing equipment was of an entirely different character. However, in a new plant, where all equipment is being installed for the first time, the individual electric drive is by far the best.

A few approximate figures show more clearly the fitness of low-pressure turbine for this application. The exhaust steam from the 700-hp. Corliss engine was more than sufficient to give 600 hp. in the low-pressure turbine. The engine takes steam at 150 lb. pressure, and exhausts into an oil separator at a back pressure, depending on the load, from 0 to 4 or 6 lb., which is approximately the pressure of admission to the low-pressure turbine. The steam is then expanded in the turbine down to a vacuum corresponding to 27½ in. of mercury referred to a 30 in. barometer, the vacuum being maintained by a Westinghouse-Le Blanc low level jet condenser and air pump. The pumps are centrifugal and are driven by a small turbine through a reduction gear. They take their water from a nearby creek and discharge it from the condenser into a reservoir at an elevation of 45 ft., which water is used in the manufacturing processes. The small turbine runs noncondensing and its exhaust steam goes to the feed-water heater, so that only a part of the heat energy in the steam used by it can be charged to the turbine, and even that cannot be charged against the main turbine for it is used to do work in elevating the discharge water from the condenser to the reservoir and should be charged against the total cost of manufacturing. In brief, it may be said, that this paper company actually gets 600 hp. without paying a cent for steam, and that it is using just one-half the steam they formerly used with two reciprocating engines to obtain the same power.

While this particular mill was not enlarged, it is evident that with a given amount of exhaust steam, either from noncondensing engines or condensing engines run noncondensing, a large increase of power is made available by the installation of a low-pressure turbine. Further evidence of this possibility for expansion is the fact that in this paper mill when the two line shafts were driven by noncondensing reciprocating engines, a battery of 13 boilers was required, whereas, now only eight boilers are required for the maximum load.

So far this has been a discussion of the application of a low-pressure turbine, but the means of transmitting its high speed power to a slow speed line shaft is fully as interesting and as important. The change in speed is made by means of two reduction gears because the first cost of a single gear and pinion of ratio 36 to 1 would be prohibitive, and the gear would be very large and unwieldy. The first speed reduction, 3600 r.p.m. to 720 r.p.m., is made with a fixed bearing type of reduction gear, the gear shaft of which is direct connected to the pinion shaft of the second gear which reduces the speed from 720 to 103 r.p.m.

This larger reduction gear is of the flexible pinion frame type, better known as the Westinghouse I-beam type. It is this I-beam feature which makes the application of the geared drive possible.

In this, the pinion is supported on three bearings in a frame, as shown in Fig. 2. This frame is supported under the middle bearing on an I-beam at right angles to the pinion axle. The flexibility of the web of this I-beam support allows the pinion to tip slightly and to let the teeth of the pinion line up with those of the gear. This lining up is entirely automatic and instantaneous in operation, so that no mechanical complications are encountered, and no adjustments from the outside of the gear case are necessary at any time.

Both reduction gears are lubricated by sprays of oil directed from the teeth just before they mesh. The pressure is maintained by a pump geared to the gear shaft, as shown in Fig. 1. This pump also supplies oil under pressure to all the bearings in the two reduction gears. For starting, a hand pump is provided which insures a plentiful supply of oil on the bearings and teeth.

It may be asked why a fixed bearing type of reduction gear was used in one case and an I-beam in the

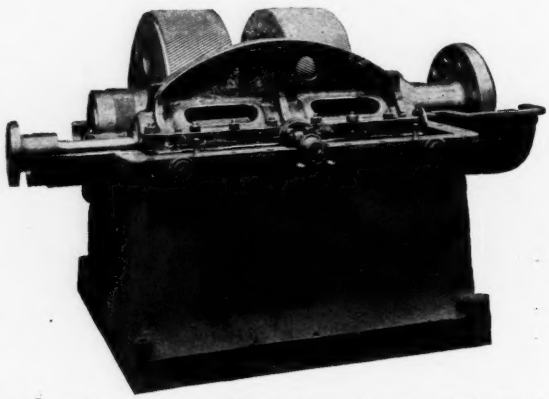
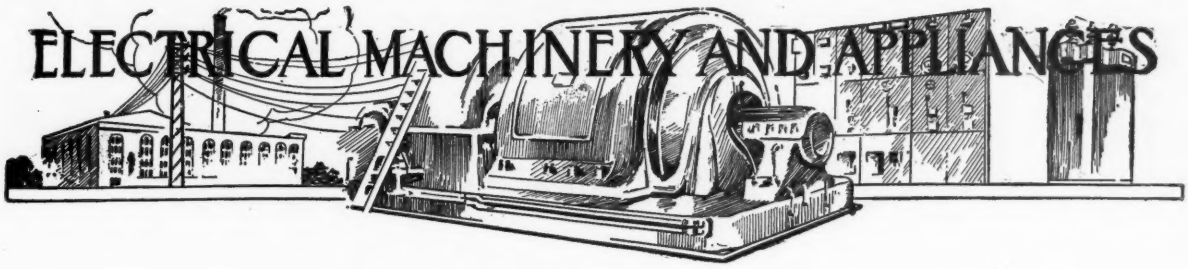


FIG. 2. THE THREE PINION BEARINGS ARE SUPPORTED BY A FRAME WHICH IN TURN IS CARRIED ON TWO SUPPORTS OF I SECTION

other. It was a question of tooth pressure which determined the design. Take, for instance, a pinion transmitting 600 hp. at 3600 r.p.m., which was the case of the first reduction gear in the particular installation under discussion. If the same pinion were to turn at 720 r.p.m. and with the same tooth pressure (i.e., pounds pressure per inch) of tooth face it would be capable of transmitting one-fifth of 600 hp., or 120 hp. only. It follows, then, that the second gear would have been made five times as large as the first if the same type had been used, and for the transmission of the same amount of power. Such reduction gear would have been large and bulky. It would also have been costly, because cost is a function of size.

The actual efficiency of the two gears together, is 97 per cent, showing that only 3 per cent of the total power transmitted is lost in them. This energy is dissipated in the form of heat, and is taken up by the oil, which in turn is cooled by a water cooling system. As to reliability, in the paper mill under discussion the double reduction gear has run 24 hr. a day, six days a week, under maximum load, and it has never been shut down on account of trouble with the gears.



The Development of Direct-Current Motors

COMPARISON OF CHARACTERISTICS AND PROPERTIES OF COMMUTATING AND NON-COMMUTATING POLE MACHINES. BY A. BRUNT

GREAT progress has been made in the development of the direct-current motor during the last 10 yr., due partly to keen competition and especially to the introduction of the commutating pole, which has made possible the replacement of the old, heavy, sparking non-commutating pole motor by the light, well-ventilated, sparkless commutating-pole motor.

The requirements which direct-current motors should meet are:

1—Commutation should be good at all loads.

2—Heating should be within allowable limits, determined by the insulation material used.

3—Speed characteristics should meet the requirements of the driven machine.

4—High efficiency.

5—Satisfactory mechanical and insulation strength.

The output of a given machine was limited at one time by the first two items in the order given. The

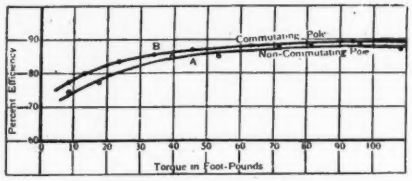


FIG. 1. FULL LOAD EFFICIENCY CURVES OF TYPICAL COMMUTATING AND NON-COMMUTATING POLE MOTORS

explanation of this fact is the history of direct-current motor development. Further progress undoubtedly will be made with ventilation, in which case the maximum output of a given machine will be determined by one of the last three items.

The maximum output obtainable from the non-commutating-pole motor was determined by commutation. In cases where, from the standpoint of allowable heating, the rating of a certain motor could have been increased, the commutation would not permit this. The allowable temperature rise generally was taken as 40 deg. C. for continuous ratings.

With the introduction of commutating poles the barrier set up by commutation against an increase in rating was removed. Not only was it possible to obtain the same output with less material, but at the same time a greatly improved motor was produced. The better commutation gave increased overload capacity and eliminated sparking at all loads in well-designed motors, with consequent increased life of commutators and brushes—the parts of non-commutating pole motors that required most attention and renewing.

HEATING AND VENTILATION

WITH the commutation limit removed as an obstruction to a better utilization of the materials, a new obstacle arose. The transformation of electrical input into mechanical output cannot be obtained without a certain percentage of the input being dissipated in the form of heat. This heat causes the temperature of the motor to

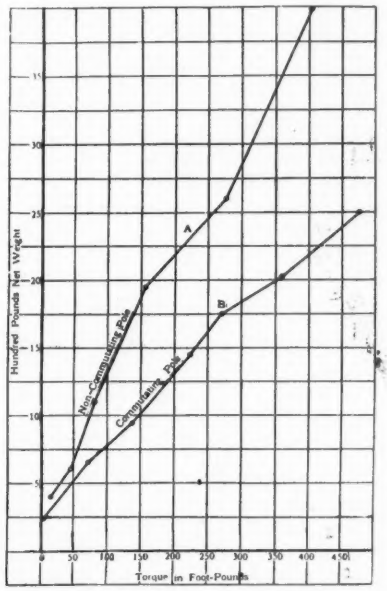


FIG. 2. VARIATION IN WEIGHT OF COMMUTATING AND NON-COMMUTATING POLE MOTORS

rise, until a constant temperature is reached when the loss in watts equals the amount of heat carried off by radiation and ventilation. The rating of a certain motor, therefore, only can be increased if the increased amount of heating due to the higher losses can be carried off by improved heat dissipation. An improvement in radiation is hardly possible since its value is determined by the total surface and by the difference in temperature between the motor parts and the surrounding air. Ventilation, however, offered opportunities for improvement. Efficient ventilation can be obtained in several ways.

The fanning action of the end windings may be employed advantageously together with a motor construction that will allow free movement of the air; or a fan mounted at the rear end of the armature may be employed to produce an air draft through the motor. The first construction is called the naturally ventilated one and the second the directed ventilated construction. Thus through improvement in ventilation a larger amount of heat can be carried off, making possible the better utilization of the motor material.

Rating

Recently, efforts to obtain maximum output and satisfactory performance with a minimum of material have led to the adoption of a new basis of rating in regard to allowable temperature rise. No advantage is obtained by designing motors so that the temperature is

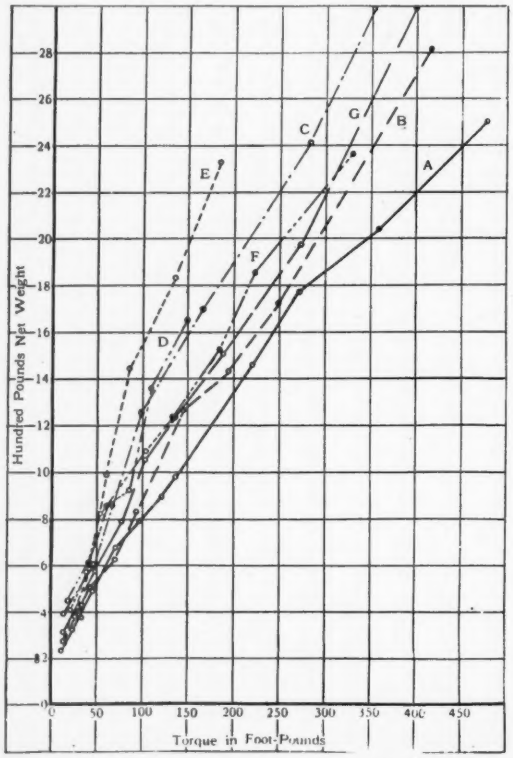


FIG. 3. COMPARATIVE WEIGHTS OF EQUIVALENT FRAME SIZES OF SEVEN DIFFERENT MAKES OF DIRECT-CURRENT MOTORS

lower than the temperature the insulating material can stand continuously without deterioration. A safe continuous temperature for cotton insulation, employed in general utility motors, has been determined as 105 deg. C. As the actual temperature cannot be measured, since thermometers can be applied only to outside surfaces, and allowing a 15 deg. hot spot correction on this account, the maximum allowable observable temperature will be 90 deg. C. On the basis of an air temperature of 40 deg. C. the allowable observable temperature rise will be 50 deg.

Whereas in the past it has been general practice to rate continuously running motors on the basis of a 40 deg. C. rise, due to the preceding considerations the rating based on a 50 deg. C. temperature rise is being used more and more for motors used in applications of which the power requirements are accurately known and which are not subject to overloads sustained for any length of time (blowers, compressors, etc.) As undoubtedly accurate knowledge of the power requirements of driven machines will increase, this basis of rating cannot fail to be adopted more generally.

Efficiency

An impression might be gained from the preceding that the progress toward a better utilization of the material has been obtained at a sacrifice in efficiency. The opposite is true. When the non-commutating-pole motor was replaced by the commutating-pole motor, the possible decrease in air-gap and the lower flux densities in the armature teeth and core materially reduced the field and iron losses, resulting in a more efficient motor. In Fig. 1, curve A gives full-load efficiencies of some motors belonging to a line of non-commutating-pole motors preceding the line of 40 deg. C. commutating-pole motors, the efficiencies of which are represented by curve B. In both cases motors of average speed have been taken.

In addition to the improvement in the conventional efficiency as indicated by Fig. 1, the additional load losses caused by local brush currents are very considerably smaller in commutating-pole motors than in motors without commutating-poles. These additional losses are not included in the efficiency curves. The efficiencies of motors rated on a 50 deg. C. basis are approximately equal to those of the 40 deg. C. motors, the higher losses in the 50 deg. motor not being so much higher as to lower the efficiency, taking into account, of course, the increased output. Thus a better utilization of the material has been obtained not only without sacrificing any desirable characteristics, but even with a gain in the most important operating characteristics, that is, commutation and efficiency. In order to get an idea of how much more economically the material is being used in a modern motor, curves giving the motor weight as a function of the torque both for an up-to-date line of commutating-pole motors and a preceding line of non-commutating-pole motors are shown in Fig. 2, in which curve A represents the old and curve B the modern motor.

Motor Weights

The curves given in Fig. 3, of seven different makes of direct-current motors show a great difference in weight between motors of the same output manufactured in different factories. Since, in order to be competitive, the different manufacturers have to sell motors of a certain output at the market price, the purchaser of these motors naturally will ask whether he should buy the light or the heavy motor. If the motors are designed to meet the same temperature guarantees and have satisfactory speed characteristics and equally good efficiencies, what then are the advantages of the one over the other?

Some may consider that they will get more for their money by buying the heavy motor. A careful comparison, however, will generally show that this is not so. If the heavy motor has more excess capacity, this should also show itself in the dimensions of the shaft and bearings. It is well known, however, that the shaft bearing sizes of competitive motors of the same rating are very

nearly the same for the two motors; it may be concluded that the same will apply to the diameter of the shaft in the core.

The lighter motor necessarily must be the better ventilated motor, which means that the motor is so constructed that the cooling air comes in thorough contact with those parts inside of the motor in which the heat is generated. Thus it follows that the excess of actual temperature measured by applying a thermometer to outside surfaces must be smaller in the light, well-ventilated motor than in the heavy motor. That this is so can be seen by comparing the temperature rise of the shunt coils, measured by the thermometer and by resistance, of the heavy and light motors represented by curves A and B, Fig. 2. The shunt coils of the non-commutating-pole motors are very bulky and show an excess of the average temperature rise (measured by resistance method) over the outside temperature (measured by thermometer) of 19 deg. C. This excess is only 12 deg. C. for the light shunt field coils of the commutating-pole motor. These figures represent averages of a great many tests on different machines. The difference between the maximum prevailing temperature inside of the coils and the measured outside temperature, of course, is still larger and still more favorable to the commutating-pole motor. The results of this comparison between the shunt coils of a non-commutating-pole and a commutating-pole motor, of course, also apply to heavy and light commutating-pole motors, since the greater total weight must be caused by heavier component parts. Since the excess of actual inside temperatures over the measured temperatures is smaller in the well-ventilated, light motor, this decreases the possibility of inside temperatures dangerous to the insulation. In this respect the light, well-ventilated motor is decidedly to be preferred over the heavier one. The light motor can also be handled easier, and will have a lower freight rate.

That great weight is not necessarily the equivalent of superior qualities is well illustrated by the curves of Figs. 1 and 2. The efficiency and especially the commutation of the commutating-pole motor are decidedly superior to the same qualities of the very much heavier non-commutating-pole motor.

Although for general purposes the light motor is to be preferred, the conclusion should not be drawn that this statement applies to all motors. Motors for certain classes of steel mill service, for instance, should be considered differently, as the frequent and tremendous overloads that are common in some steel mill applications make rugged construction of primary and performance of secondary importance. For this class of service great weight, indicating heavy component parts, is considered as an asset.

Induction motors, also should be considered in a somewhat different light, since they are used for applications of a different nature as compared with direct-current motor applications. Induction motors are used where a constant speed is required without speed adjustment. The elimination of the speed adjustment requirement leads to more stress being put on other characteristics, such as efficiency and power factor. While an induction motor of a certain horsepower and speed costs considerably less than a corresponding direct-current motor, the latter are bought for different and very definite reasons as, for instance, required speed adjustment (machine tools, blowers, printing presses), frequent starting and stopping (elevators), regeneration and dynamic braking (elevators, reversing planer motors), variable speed (compound-wound motors for shears, presses). Thus the direct-current motor is bought primarily on account of some one of its characteristic qualities, whereas induction motors are bought primarily for efficiency. The weight, therefore, although an important factor, usually is considered secondary to efficiency. It should not be assumed, however, that the efficiency of direct-current motors has been neglected.

Economic Features

From an economic standpoint the excess weight of a heavy motor over a lighter motor, that could have been built to give the same satisfaction, represents a waste of materials. The magnitude of this waste can be approximated roughly as follows: The records of a prominent manufacturing concern indicate that the average size of direct-current motor sold for general utility has a torque of 65 ft.-lb. This size of motor can be bought with a weight varying between 605 and 1080 lb. (Fig. 3.) Assuming the average weight of motors of 65 ft.-lb. torque to be 845 lb. and further assuming a total production in this country of 30,000 motors per year, the waste of material by using the average motor instead of the lightest motor will be $(845 - 605) \times 30{,}000$, or 7,200,000 lb. per year. This figure is appalling, especially under present conditions, when it is so important to economize in the use of copper and steel. The policy of economizing should be carried through into details, for which reason attention is called to the possibilities in connection with the production of general utility direct-current motors.—The Electric Journal.

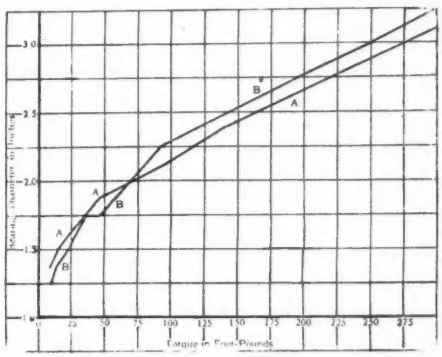


FIG. 4. VARIATION OF PULLEY END BEARING DIAMETER OF TWO TYPICAL COMMUTATING POLE MOTORS

Don't Wait for Anthracite Coal

Recent records of coal production by the bituminous mines show satisfactory increase over 1917 figures. The week of July 13 showed 13,243,000 tons, the highest record yet for a week's production.

Anthracite delivery to central west sections is, however, far from satisfactory, and consumers who are expecting delivery for house heating will do well to arrange for a supply of local bituminous coal, as the present outlook is that little anthracite will be delivered west of Pennsylvania.

Advantages of Switch Boxes With Interchangeable Sides

By Thomas L. McGraw

THERE ARE two general type of removable side switch boxes on the market. One type, illustrated in Fig. 1, has one side, R, removable and the other, N, non-removable. Whereas, boxes of the other type, Fig. 2, have side stampings, S and S, which are duplicates, hence interchangeable, and both are removable. It will be shown that the interchangeable-side boxes, of

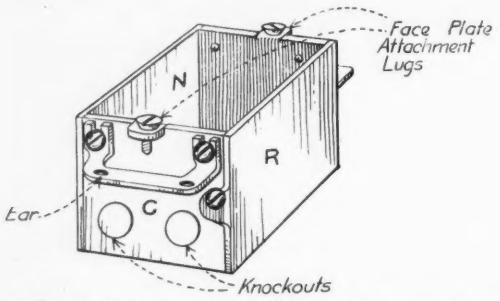


FIG. 1. BOX HAVING ONE REMOVABLE AND ONE NON-REMOVABLE SIDE

which that illustrated in Fig. 2 is typical, are preferable because of their flexibility of application.

The only reason for stocking boxes with removable sides is to enable the installer to "build up the boxes" into "gangs" of two or more units, when it is desirable that a number of switches be installed side by side. In assembling a multi-gang box, Fig. 3, using units of the construction of Fig. 1, the removable side plate or stamping, R, is taken from the box, C, and spacers, A and A, are attached, until the gang comprises the required number of units. The side plate, R, is now added. The resulting gang, Fig. 3, is entirely satisfactory mechanically and electrically; but its chief disadvantage lies in that, where it is used, it is necessary for the contractor to stock the regular single-box units, C, and also the filler or spacer unit A.

Inasmuch as both sides, S and S, of boxes of the type of Fig. 2 are duplicates, they may be built up into gangs

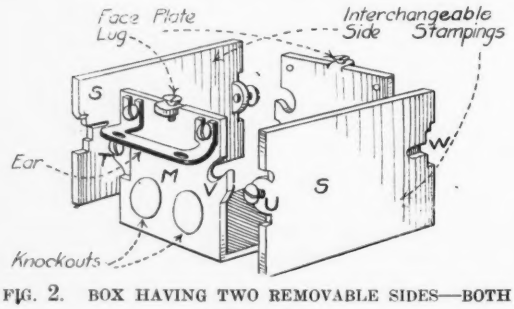


FIG. 2. BOX HAVING TWO REMOVABLE SIDES—BOTH DUPLICATES

of any required capacity by merely clamping together the necessary number of box units and adding the two side stampings. The boxes of Fig. 2 may be purchased with or without the side stampings. Hence, if an excess of side stampings accumulates, due to the box stampings, M, having been used in gangs, additional box stampings may be ordered.

Each side stamping, S and S, is held to its box by two screws, T and U. One of these screws, U, turns in a lug or ear bent on the end of the side stamping and clamps in a notch, V, cut in the box stamping. The other screw, T, turns in the box stamping and, when set up, engages in a recess, W, in the side stamping. When both of these screws are tightened, the sides of the box are clamped into one rigid unit. It is apparent, therefore, that, if a box of this type of Fig. 2 is adopted, it will be necessary to stock only (1) box units, M, and (2) side units, S. On the other hand, if a box of the type of Fig. 1 is adopted, it will be necessary to stock at least three parts: (1) box units, C; (2) spacer units, A, and (3) side units, R, which demonstrates the desirability of the interchangeable-side box of Fig. 2.

Coal Saved by Plants at Pittsburgh

THOMAS R. BROWN, administrative engineer of the United States Fuel Administration for the Pittsburgh district, in a report just received in Washington, says that through the inspection of industrial steam plants, which was begun there only a few weeks

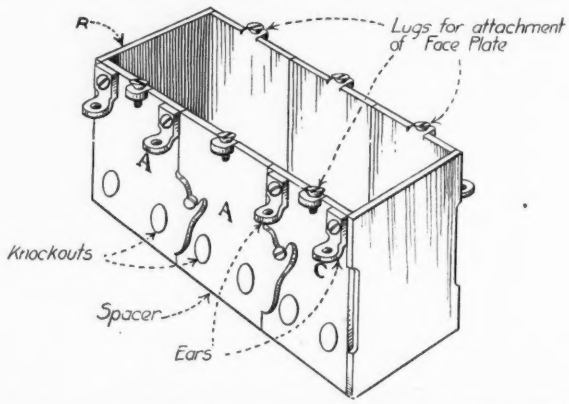


FIG. 3. GANG BUILT UP FROM TWO SPACERS AND A BOX HAVING ONE REMOVABLE SIDE

ago, a saving of 81,000 tons of coal per year has been effected in the Pittsburgh district. This saving represents a little more than one week of actual inspection under the general program recently announced by the Fuel Administration.

Mr. Brown's report discloses the startling fact that one great plant operated in his district was rated only 59 per cent of efficiency in the use of coal. If this ratio, or anything like it, should hold good for the industrial plants in other districts where the efficiency is recognized as not being nearly so high as in the Pittsburgh district, then the Fuel Administration feels assured that it will be an easy matter to save from 25,000,000 to 30,000,000 tons in the 250,000 industrial plants in the United States without in any way reducing the quantity or quality of the output. However, in fairness to the Pittsburgh district it may be said that the report shows an average efficiency of almost 80 per cent.

The Official Bulletin.

Crank Repairs

DIFFICULTIES ENCOUNTERED AND REMEDIES EMPLOYED. BY C. E. ANDERSON

DURING the past season of the ice and refrigerating industry I have had an unusual run of crankpin and crank disk troubles to solve and remedy. The methods used in overcoming these troubles might be of interest and useful to readers of Power Plant Engineering.

The first crankpin trouble encountered was in a refrigerating plant operating an old-time ammonia compressor, having two upright ammonia cylinders, and driven by a horizontal steam engine. The shaft on which the ammonia compressor cranks were connected was driven by means of a double crank disk, located between the ammonia cylinders.

The pin between the disk had worked loose and was pounding and heating to excess, and there was some danger of cracking the disk. No amount of peening or riveting the pin into the disk seemed to help or hold the pin tight. As time was a greater factor than anything else, it was necessary to devise some scheme or method to repair it quickly. Making a new pin was out of the question. The compressor could not be spared long enough to dismantle and insert a new pin, so we decided to insert taper pins, as shown in Fig. 1. In each end of the crankpin we drilled and reamed four holes for number 7 taper pins (about ⅜ in.) into which we drove with a sledge four of such sized pins.

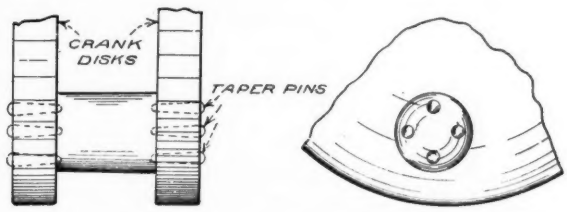


FIG. 1. CRANKPIN TIGHTENED BY USE OF TAPER PINS

These pins forced the metal in the crankpin hard up to the disks, and it made a good tight job of it, in fact as tight as any ordinary means could produce. I allowed about ½ in. for driving the pins, but when they were driven about ⅜ in. they were tight, and as far as we could drive them.

This compressor has run 24 hr. a day all last summer, and so far the pin is as tight now as it was the day we finished the repair.

In another instance the crank disk on the high-pressure side of a cross compound engine driving a generator worked loose, and it was decided to replace it with a new one.

A new disk was cast, and we bored it in the shop for the shaft and crankpin, according to sketch furnished us by the master mechanic of the plant. In due time we arrived on the job with the new disk and all our paraphernalia for making this change—that is, pulling off the old disk and shrinking on the new. We were met by the master mechanic and received our instructions on what he wanted and what he did not want, regarding the work in question.

He was one of these fussy old fellows who seemed to carry the responsibility of the world upon his shoulders. One of our helpers nicknamed him "Whiskers," which fitted him as well as any.

One thing Whiskers kept drumming into our ears whenever he had the opportunity was "service must not be interrupted," and "this engine must run by sundown." These instructions were firmly fixed in our minds by the time we started on the job. To remove the old disk as soon as possible we decided to split it, which was accomplished by drilling holes through the disk along the diameter as shown at the lift in Fig. 2. Taper pins were driven into these holes with a battering ram, which split the disk as shown in the sketch.

After removing the old disk we commenced to heat the new one with an oil furnace, preparatory to shrinking. In the meantime I calipered the shaft and was somewhat surprised at the measurements, as in my estimation the new disk was bored too small. I called Whiskers' attention to this, also to the fact that the new disk was composed of very hard, brittle cast iron. This brittleness I noticed when boring the new disk in the shop. I was almost certain that the disk would crack when shrunk on the shaft and informed Whiskers to this effect, but he replied that the measurements were correct and this was the way he wanted it. The disk was made of a special composition of metal, according to his own ideas, and all I had to do was to put it on.

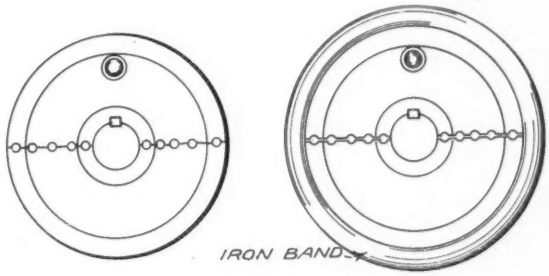


FIG. 2. (A) METHOD EMPLOYED TO REMOVE OLD CRANK DISK (B) DAMAGED DISK HELD SECURE BY IRON BAND

I heated the disk, forced it in place, and waited for it to cool and shrink.

In the interval, while removing the rigging, used to press on the disk and waiting for it to cool, Whiskers kept walking around the engine with a smug and satisfied countenance, thinking what fools we were to imagine the disk would crack, which idea we still entertained and did not miss any opportunity of telling him so.

The disk was cooling rapidly and we were preparing to assemble the connection rod, when there was a sharp crack like the slap of a belt. We all hurried over to the disk and found it cracked from shaft to rim by way of the crankpin.

I have never seen a man so excited and distracted as old Whiskers—he seemed to float all around that engine, hardly stopping in one spot for more than half a second.

We remarked that "service would be interrupted"

for some time at least, and suggested that the quickest and best way to remedy this difficulty would be to use the old disk again until a new one of softer metal could be made. While we were pulling off the cracked disk, which we had heated, of course, in the meantime, Whiskers had the blacksmith of the plant forge two iron rings, or bands, out of 3 by 4-in. iron bars, which were bored out about 3/16 in. smaller in diameter than the old disk. The edges of the two halves of the old disk were chipped away, so they would not be drawn together by the band, thereby insuring a tight fit on the shaft. The disk was also filed out slightly at the broken edges of the hub, to prevent the sharp edges from nicking the shaft while being drawn together by the band.

The two halves were put in place on the shaft and temporarily held together by iron straps, bolted to the face of the disk across the crack. The iron bands were then shrunk around the disk, leaving the job as shown at the right in Fig. 2.

This disk was run until a new one was made and put on, and from appearances and performance would have lasted for some time to come. The removal of the old disk, when the new one arrived, was accomplished in a

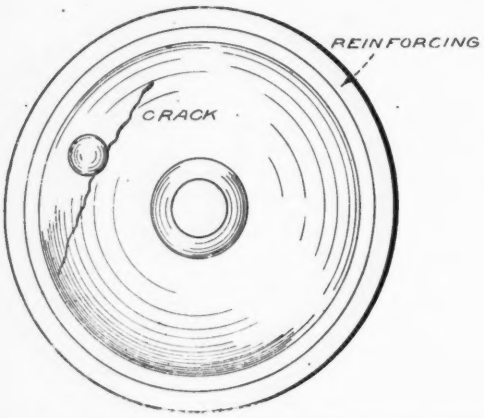


FIG. 3. PIN SECURED BY PRICK PUNCHING BEARING SURFACE AND USING REINFORCED RING ABOUT DISK

few minutes by cutting the bands with an oxy-acetylene flame.

Not long ago I was called over to an ice plant; they telephoned that their ice machine had turned into a steam hammer.

There was no difficulty in finding the location of the plant. I could hear and smell it for some distance. When I arrived I found the crankpin and disk were very hot and pounding heavily at every revolution of the engine.

After shutting down, we found that the disk was cracked through the pin both ways to within an inch or so of the rim in manner shown in Fig. 3. The pin was turning in the disk, which accounted for the excessive heating of the connecting rod brasses and the disk. We called for a couple of blacksmiths to come out. When they arrived we forged a ring out of some 2 by 4-in. steel and bored it 3/64 in. smaller than the diameter of the disk.

While we were heating the ring in a wood fire, preparatory to shrinking it on the disk, I removed the crankpin by means of a sledge, and prick punched it all around and drove it home again. When the ring was sufficiently hot we forced it on the disk and let it cool. After it had cooled and shrunk on the disk the crack was drawn together so tight that we could hardly notice it. This disk ran all last summer and has given good service, and the pin is as tight, to all appearances, as when the disk and pin were new.

In a large packing house, one of the cross compound engines driving a duplex ammonia compressor developed a severe pound, which was rather difficult to locate. The plant force had examined the piston on the steam and ammonia ends of the machine and found them tight and in good order. It was evident that the pound did not come from a loose piston.

We tightened up all the crosshead shoes, connecting rod brasses, wristpin brasses, and the pillow block bearings, until they all ran warm; still the engine pounded.

There were only four things left that we had not examined in trying to locate the pound, namely, loose flywheel, crank disks, crankpins and crosshead pins. We examined the flywheel and found it tight on the shaft. Next in order was the crankpin, and on the high-pressure side of the engine we found the trouble. The disk was loose on the shaft. As the disk was very large and

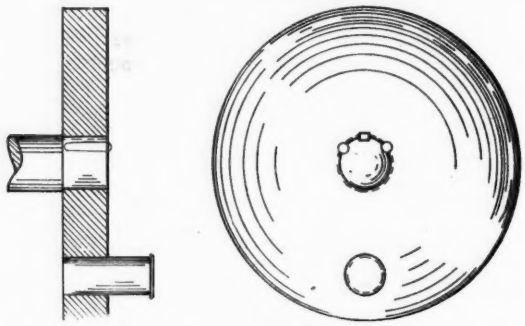


FIG. 4. FASTENING A LOOSE CRANK DISK WITH TAPER PINS AND KEY

heavy to handle and work, and would cost a small fortune to renew, it was decided to make some sort of repair that would take the least amount of time and at the same time be practical and permanent.

Several suggestions were offered—some good and some bad. Time was an important factor to be considered, as this was one of the main units, and the plant was running considerably under capacity when this unit was shut down (800 tons refrigerating duty). We decided finally to tighten the disk onto the shaft by driving in taper pins, shown in Fig. 4. We drove out the key and drilled two 1-in. holes about 45 deg. each way around the shaft from the center of the keyway, with half of the hole in the shaft and half in the crank disk. After drilling the 1-in. holes, we reamed them out with a taper reamer. After the holes were reamed and found to be satisfactory, we made two tool steel pins and fitted them accurately into the holes. Two sides of the pins were then planed away in such a manner that they would have a bearing on opposite sides of the holes only. We placed a 0.007-in. steel strip under the old key and commenced driving in the key and the two pins simultaneously with sledges. After we had them driven up as

far as we could, the projecting ends of the key and pins were chipped off and filed flush with crank disk.

On starting up this unit again the thump in the engine was gone, and undoubtedly we had solved the difficulty. This unit is in service practically 20 hr. each day, almost the year around; this particular repair was made last winter, and the unit has been in constant service since without showing any loosening of the disk.

Fire Up! We Need the Pressure

By C. H. Stephen

TO make a claim is one thing,
But, to prove that it is right,
Often puts the thing in question
In a very different light.
In the monkey wrench profession
I have often heard it said,
That an engineer in these days
Has to have a level head.

I'm not fighting the assertion,
For I know there's something in it,
And conditions make the question
More important every minute.
We're the power behind the power
That makes factory wheels go round,
And the present path of duty
Leads us over holy ground.

Our country's in a conflict
That we all must help to win,
Every duty now neglected,
Constitutes a mortal sin.
'Tis no longer just a question
Of employer and employed,
It's the question of our homeland
Its destruction to avoid.

It's the question of our giving
All the good that we possess,
Advocating by our living
Democratic righteousness.
It's a question of upholding
Uncle Sammy in the fight,
Not because he's Uncle Sammy,
But because we know he's right.

It's the question of the coal pile,
It's the question of the oil,
It's the question of ammonia,
And of honest, manly toil.
It's the question of upholding
All our boys that are away
Who are fighting or preparing
To join in this fearful fray.

It's a question of our home-life,
It's a question of the heart,
It's a question that excuses
None who fail to do their part.
It's a question of our children,
Of our meat and daily bread,
It's a question that will prove, boys,
Whether we have level heads.

Preach it when around the engines,
Preach it from the boiler floor,
Preach it to your factory comrade,
Then go out and preach some more.
Don't let German propaganda
Come around and stuff your nut
With the fact that you're ill-treated,
Making out that you're a mutt.

When your partner starts to grumble,
Squelch it as you would a crime;
Relegate your fancied grievance
To a more propitious time.
Let's remember we are units
Of a monstrous big machine,
That for fairness holds a record;
Let us keep that record clean.

Let each engineer existing,
First remember, he's a man;
Let him prove that he's a credit
To our democratic clan.
Let him back his own employer,
In this fierce commercial strife;
For upon the country's commerce
Hangs your brother soldier's life.

Let him know the part he's playing
In this scrap for liberty
Bears a strengthening, cheering message
To our boys beyond the sea.
Boys, remember, we're no numskulls,
We are men, and want to prove
That we're worthy of our country,
And will boost its every move.

Let the brains that we've developed
In around the engine-room,
Do its damnedest in providing
Stuff to make the cannons boom.
Stuff to feed and clothe the Sammies
Who are fighting in the trench
With the English and Italians,
With Canadians and with French.

Stuff to help poor bankrupt Belgians,
In their grand heroic fight,
Who have had to bleed and suffer,
Just because they stood to right;
Stuff to feed the starving nations
That are suffering o'er the sea,
Not to conquer land or people,
But to down autocracy.

Give your dollars, give your efforts,
Give your moral strength as well;
Engineers who love your country,
Help to give the Prussians hell.
They deserve it, they have earned it,
Let them have it, 'tis their due;

Don't wait for the other fellow,
Duty's calling, it means you.

Cast your mind's eye on the future,
And the things it holds in store,
If that ugly Prussian spirit
Puts its feet upon our shore.
How about those little children
That you're striving hard to raise?
Are they doomed to Prussian curses
Or to freedom's holy praise?

What of future generations
That depend upon our acts?
Engineers that love your country,
Face about, and face the facts.
You've intelligence and manhood,
In your hands the throttle lies;
Turn the steam on for Old Glory!
Let the furnace fires rise!

Fire up! we need the pressure.
Put your efforts to the test!
Uncle Sammy's up against it,
And he's asking for your best.

The Theory of Graphite Lubrication

A Simple Test to Prove It

THE theory of all lubrication is to keep two surfaces apart. In theory this is correct, and also correct in practice with this one exception. Any oil or grease will stand weight or stress up to a certain limit; but if unusual weight or stress is placed upon the machine, the oil or grease will squeeze out from between the surfaces and allow the metals to touch.

Metals are never smooth. Under a microscope the most highly polished piece of metal resembles a nutmeg grater. There are little pin points sticking up, pores in the metal, tool marks and other irregularities. When the oil or grease squeezes out these irregularities interlock; this is the cause of "friction." These little pin points also break off; this is termed "wear." Tiny particles of metal get into the lubricant and, returning through the bearing parts, act as an abrasive. The proper lubricating graphite entirely overcomes this. It first fills in the pores of the metal, after which it places a veneer over the entire wearing surfaces. After the graphite veneer has been secured, friction will have been reduced to the absolute minimum known to mechanics. Not only this, but wear of metals will be prevented for the reason that contact now is between graphite-and-graphite and not metal-and-metal. It is obvious that if metals do not rub together they cannot wear.

To demonstrate, take two small pieces of hardfaced paper. Lay one upon the other and try to move the top piece over the bottom one by applying weight and force. It is friction that holds the two pieces of paper together. Now take some fine flake graphite and rub a little on each piece of paper, place the graphited surfaces together and do the same as before. You now find that the papers move readily one upon the other. To show this further, take one piece of paper on the corner of which is no graphite, and rub upon the other graphited piece, rubbing for quite a time and in all directions, so as to work the graphite thoroughly into the paper.

Now look at the paper and you will observe that the graphite has filled in the pores of the paper, after which it has placed a veneer over the entire surface. Rub your thumb over the graphited part and you find that it does not rub off.

Lay the two pieces of paper together and rub as before, placing weight upon it, and you find that the more weight applied—in other words, the more work flake graphite is given to do—the easier it moves, and, unlike oil or grease, does not and cannot be squeezed out from the point of contact. In fact, it gathers at the point of contact until it has filled up the pores and irregularities in the paper.

This test illustrates the truth that, irrespective of weight, a film of graphite cannot be squeezed out. In fact, the more weight applied, the firmer it is embedded in the metal and the smoother the surface becomes.

Statistics show that of each 1,000,000 men engaged in the present war, 10,000 will be so injured that they must be re-educated for work other than that which they did before entering the army. Over 80 per cent of the disabled men can be re-educated for useful, self-sustaining employment, so as to become a valuable part of industrial organization instead of being dependents. This knowledge is a comfort to the friends and relatives of men going to the front, as well as to the men themselves, and the Federal Board for Vocational Eduction is taking up the great task of this re-education so that the instruction may begin at once as men who need it return to us from France. On the basis given, some 30,000 men must be taken care of this year, which gives an idea of the size of the problem.

It is a duty of those in executive positions in the plants of the country to begin now to plan how they may help in utilizing these men, not as a matter of charity, but in positions where they can make good and maintain their places as legitimate, self-supporting workers.

Prices for bituminous coal for the Northwest have been reduced by the Fuel Administration to purchasers in carload lots at any Lake Michigan or Lake Superior dock. These prices are based on freight rates now effective between the mines and Lake Erie ports, and any increase in such rates ordered by the Railroad Administration may be added to the prices as given.

For Youghiogheny, Fairmont, Greensburg, Westmoreland, No. 8 seam, Ohio and Hocking and Pomeroy fields, lump price is $5.80; run of pile, $5.55; screenings, $5.30. For Harlan, Thacker, Kenova and Kanawha fields, lump price, $6.30; run of pile, $6.05; screenings, $5.80. For Pocahontas, New River and Tug River fields, lump price, $6.30; run of pile, $6.05; screenings, $6.05.

Twenty cents a ton is allowed to licensed jobbers handling coal from the docks. These prices are to remain in effect until April 30, 1919.

Setting Valves of an Old Time Corliss

IN THE cut is shown one of the earlier types of G. H. Corliss engines equipped with a valve motion which is noted for its quick opening. The valve setting of this type differs from that of other Corliss engines. Drop a plumb bob from wristplate center to bottom hook rod pin, then make the steam valve links each 10 in. from center of pins, make exhaust links 7 in. from center of pins and move wristplate until center mark on hub comes opposite one extreme travel. Then see that the dashpot rod is just long enough to pick up the valve with a 1/16-in. clearance, then put the wristplate on the other extreme travel mark and repeat the same work. Now put the wristplate central again and with steam valves both hooked up the steam valves will show ¼-in. lap and the exhaust valves will have 1/16-in. lap. Raise the governor until the governor lever and its pins marked 1, 2, 3, 4 are exactly level, then make the gov-

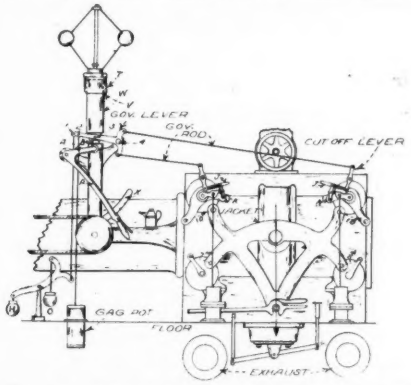


FIG. 1. VALVE GEAR OF OLD TYPE CORLISS ENGINE

ernor rods of such a length that the cutoff levers for both crank and head end will stand vertical.

With governor in this position, the steam valve should trip equally just before the piston reaches ½ stroke. If not, change one of the governor rods. Next raise the governor until it strikes the collar, then rock the wristplate until the center mark on the hub comes to the extreme mark, in which position the valves should not pick up on either end. Next, drop the safety lever, AA, until it is in its lowest notch, which is like taking out the safety pin in other Corliss engines; this allows the governor to drop to its lowest limit and in doing so there is a little trigger at the bottom marked B which trips the governor and keeps the valves from picking up as is the case when the governor belt breaks; this will also happen if lever AA is forgotten to be pulled up to second notch when shutting down, in which case the governor will have to be reset. Put lever AA up to the top notch, then let down to the middle notch, which is the same as safety pin. Then, after speed is attained, the lever is to be placed as shown, which is the same as the safety pin taken out, as in other engines. The speed of the engine can be increased by adding weights at O, or decreased by adding at H, but for large changes the governor pulley should be changed. The wooden knock off blocks at JJ should be given attention, as they will wear and are liable to break. I have found that maple is the best to use here; also spring KK is sometimes broken.

When the safety lever A is forgotten while shutting down, the governor weights drop to their lowest resting place and the little trigger at the bottom of W trips the governor and causes counterweight W to telescope into T at V, and this is caused by ball H at the bottom being heavier than O. As I said before, these weights O and H are also used to change the speed by adding to or taking from O its weights, or the same at H, but H should not have too little weight because upon this depends the power to overcome W and cause it to telescope into T. As will be seen, this carries the governor

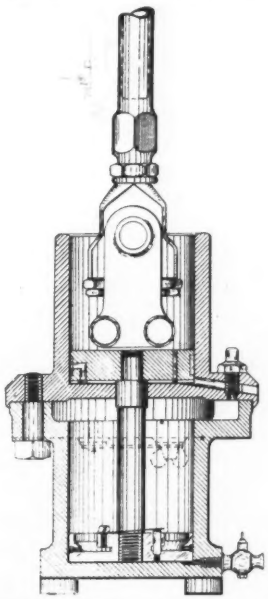


FIG. 2. DOUBLE PISTON, VACUUM TYPE DASHPOT

rod arms, and they move each rod so the valves will trip and not pick up the steam valves in case the governor belt breaks or comes off.

These engines were often steam jacketed. The one I have worked on was an 18 by 42 by 66, the jacket volume is 9697½ cu. in. and has boiler pressure in it, with an Anderson trap on the drip and I found that the condensate coming from this jacket as discharged from the trap amounted to 25 lb. of hot water every 11 min.

or 1350 lb. of water a day, 10 hr., which is equivalent to 4 boiler horsepower per hr. This was only 1/3 loaded at 75 lb. boiler steam. If the valve bonnets leak they should be packed with a common wrapping paper gasket, one thickness with graphite. The dashpot is plainly shown here and is of the double piston vacuum type.

It will be noticed that the hook rod is attached to the bottom of the wristplate, consequently the eccentric follows the crank, or 45 deg. from it; this would not follow the crank as closely except for the reason that the eccentric rod inclines downward to the rocker arm.

A. C. WALDRON.

Repairing a Main Bearing

IT WAS REPORTED that one of the main bearings of one of our compound engines had become hot and the babbit started.

Blocking was placed on the floor over the foundation with a building mover's jack under the shaft on each side of the flywheel; a nose jack was located so it would bite under each of the disk cranks as shown in Fig. 1.

By taking up on all the jacks together we raised the shaft off the cellar box about 0.2 in. The eyebolts were screwed into the quarter boxes and lifted out with the chain falls. Then with a hook, the cellar box was turned around the shaft and lifted out of the housing.

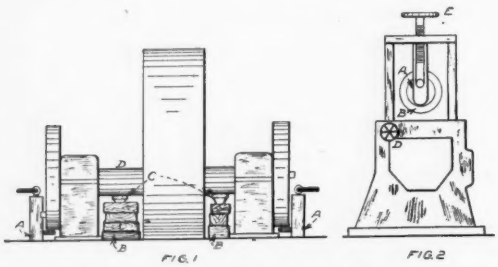


FIG. 1. USE OF JACKS TO RAISE SHAFT

FIG. 2. FRAME ARRANGED TO SUPPORT CARBORUNDUM WHEEL

While the bearing was being rebabbited the carpenter was instructed to make a false bearing of wood securely clamped together and located on the blocking between the flywheel and damaged bearing. The jacks A A and C C, Fig. 1, were lowered until they cleared the shaft. This artificial bearing was now securely braced sideways.

A wooden frame was made and secured to the pillow blocks as shown in Fig. 2 to hold the home-made grinder B.

This was an electric drill we had fitted with a small carborundum wheel on an arbor held in the drill chuck. A belt was put on one of the cranks disks and a small vertical engine, used to drive one of the induced draft fans, was located to turn the shaft. Connecting the electric drill to a line, we were ready for business. The grinder was fed along the shaft by turning the hand wheel D and the depth of cut regulated by the hand wheel E, Fig. 2.

When the shaft had been smoothed up and bearing made ready, the jacks were used to raise the shaft, the false bearing taken out and the rehabilitated bearing put in.

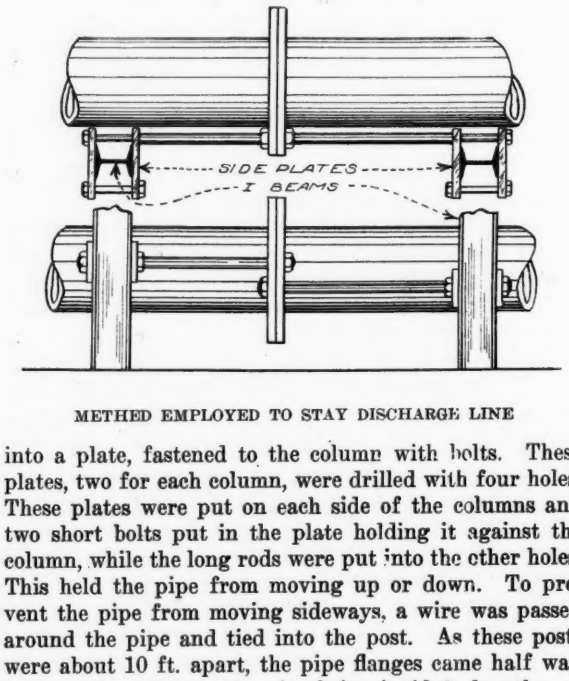
The several engine parts, with the exception of the bearing cap, were assembled. Sapolio was mixed with oil, and the engine started slowly. The sapolio was liberally applied to the bearing, which was then ground into a good running fit. Kerosene was used to flush out the bearing, care being taken to do a good job; then the bearing was flooded with the regular oil, the engine was stopped and the cap put in place; the engine was then started under load when the bearing was given the proper running adjustment and liberally supplied with oil for a few days until the parts wore themselves in.

RECEIVER.

Temporary Support for Piping

DUE TO the discharge trench for a condenser giving away, it became necessary to install a temporary discharge line. The piping consisted of galvanized pipe, with cast-iron flanges. As it was necessary to have this pipe a little above the floor, we placed a block beneath the pipe. In order to stay the piping, the following scheme gave excellent service for this temporary job:

Two long rods threaded on both ends were used, being measured approximately, before one end of the rod was put through the bolt hole in the flange, and the other end



METHED EMPLOYED TO STAY DISCHARGE LINE

into a plate, fastened to the column with bolts. These plates, two for each column, were drilled with four holes. These plates were put on each side of the columns and two short bolts put in the plate holding it against the column, while the long rods were put into the other holes. This held the pipe from moving up or down. To prevent the pipe from moving sideways, a wire was passed around the pipe and tied into the post. As these posts were about 10 ft. apart, the pipe flanges came half way between the columns, the pipe being in 10 ft. lengths.

DEAN B. COBB.

Taking Thought

AS A RULE a sugar factory produces hot condensates in excess of boiler makeup requirements, hence the cold water makeup line is seldom used. This makeup line happens to be the lowest point in our water system and is therefore prone to collect sediment.

One stormy morning our water supply reservoir was flooded with surface water, and for several hours the pipe line ran a mixture of assorted real estate of such semi-fluid consistency that "Mac," who is my man Fri-

day, compared it unfavorably with the "burgoo" compounded by his lamented grandmother.

I had just stepped out to lunch when it behooved our water tender to "give her a drink" from the cold makeup line, as his hotwell was a trifle low. On returning, I was greeted with a series of oaths—slow, deep, rumbling and Scotch.

On tracing them to the feed pumps, I found "Mac" ankle deep in scalding mud, which he had been digging out of the water end of the No. 1 pump. No. 2 was moving slowly but to no purpose, as the gages showed only 1½ in. of water.

Leaving "Mac" to continue his profane excavations in No. 1, I made a hurried examination of No. 2. Valves all good; bonnet packing sound; plunger packing tight; all clear; nothing doing.

Business of thinking: "That main check valve—it generally raps when working—the line is cold up to it, and hot beyond—maybe full of mud, forced in by the other pump."

We quickly closed the stop valves and unscrewed the bonnet of the check, and there was the stoppage. Two minutes later, No. 2 was pushing the water gages up to normal again, while "Mac" wiped sufficient mud out of his eyes to see this moral of my drawing: Always *think* before you take the pump apart.

H. K. SCHOLEFIELD.

Estimating Stack Temperature With Draft Gage

AS THE necessity for the utmost economy in the proper combustion of fuel becomes more urgent, the value of instruments for the detection and correction of the various losses in the boiler room becomes more apparent.

The value of these various instruments has been appreciated by the larger plants and every modern means have been provided to secure the best results from fuel. The installation of these instruments has been dictated by sound business principles, the value of the investment giving handsome returns on their cost.

But more urgent reasons should prevail today and urge the adoption of instruments hitherto frowned upon by reason of their cost. A dollar saved today in the burning of coal, means more than the mere buying power of the dollar saved. It goes back to the mine and saves energy: energy to mine the coal, energy to haul it and energy to fire it. Energy will be saved and energy will win this war.

In the combustion of coal a considerable portion of the heat of the coal is lost up the chimney. Some of this loss is unavoidable. The percentage of the heat thus lost is proportional to the temperature of the fire and of the flue gases.

For instance, if the temperature of the fire is 2400 deg. and that of the flue gas 600 deg., the loss will be 600/2400 or 25 per cent. From this we see that to lower this loss we should burn our coal at the highest temperature and at the same time keep our stack temperature as an indication of the efficiency of combustion.

In small plants the expense of securing thermo-electric or expansion pyrometers to indicate stack temperatures is considered prohibitive; but this temperature can be determined approximately by means of a draft gage, which should be in every boiler room.

From "Steam, Its Generation and Use," the following formula and deduction is taken:

$$D = 0.52\ H \times P \left(\frac{1}{T} - \frac{1}{T'}\right)$$

D = draft in inches of water.
H = height of stack in feet, above grate.
P = atmospheric pressure or 14.7 lb. per sq. in.
T = absolute atmospheric temperature.
T′ = absolute temperature of the stack gases.

For convenience, the product $0.52 \times 14.7 \left(\frac{1}{T} - \frac{1}{T'}\right)$ which we will call K, for the various values of T′, assuming T as 69 deg. F. and P as 14.7 lb. is given in the table below:

Constant K	Temp. Stack Gas
.0084	750
.0081	700
.0078	650
.0075	600
.0071	550
.0067	500
.0063	450
.0058	400
.0053	350

The formula will now stand: D = K H, or allowing for friction losses, the available draft, D′ will be 0.8 D, and the formula for use will be

$$D' = 0.8\ H\ K$$

Ex. Supposing our stack was 100 ft. high and our draft gage showed 0.6 in. Then from the formula

$$0.6 = 0.8 \times 100 \times K \qquad \text{or} \qquad K = \frac{0.6}{0.8} = .0075$$

From the table we find the value of K for .0075 corresponding to a value of 600 deg. for the temperature of the flue gases.

The determination of the fire temperature may be approximated from the color of the emitted light. The following table compiled by White and Taylor, Trans., A. S. M. E., Vol. XXI, gives the color and the corresponding temperature:

Color of emitted light	Temperature—Fahr.
Dark or blood red	1050
Dark cherry red	1175
Cherry, full red	1375
Light cherry, light red	1550
Orange	1650
Light orange	1725
Yellow	1825
Light yellow	1975
White	2200

JAMES M. PURCELL.

Cold Weather Difficulties

OWING TO traffic difficulties. I reached the plant 2 hr. late one morning, found one battery fired up and another being started. The water-columns of this battery were full of ice and had not been thawed out. Fires were checked and I began trying to locate water. I found it

in the combustion chamber as the ell on blowoff had frozen and bursted. A few loose rivets and lots of loose scale were the only bad results.

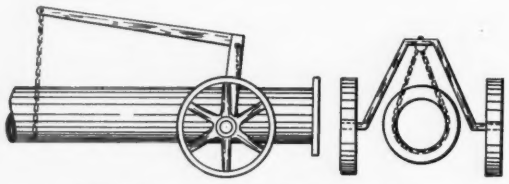
One night the engineer and fireman were trying to outdo each other sleeping, leaving the Stirlings to go it alone. Soon the steam was low, the water still lower. After much arguing between fireman and engineer the injector was started; nine tubes also started and all hands followed suit.

In regard to steam gages and zero weather, we had an amusing experience. Four boilers were on the line and one pair to which a gage was connected faced a door, open for wheeling out ashes.

In a short time, a badly rattled fireman told me one battery had 60 lb. and the other 140 lb. and I had better come quick. As I was having other trouble, I waited and when the gage registered 180 the fireman started home. When the gage piping was thawed out, however, he consented to remain. J. C. L.

Handy Pipe Moving Appliance

In new construction work, where many pieces of good sized pipe must be moved about, the use of the ordinary low truck is unsatisfactory because it necessitates lifting the pipe into place and further gives trouble from rolling off or tipping at the end, if not



PIPE CART AND METHOD OF USING

nicely balanced. As a substitute, a simple carrying device, as outlined in the accompanying illustration, proves to be a time and labor saver and is readily made by a blacksmith, with a pair of light wheels.

The carriage is wheeled over the pipe, the chain at the front fastened under the pipe, and then the lever end is pressed down toward the pipe and fastened to it by means of the chain or rope, with the result that the fore part of the beam of the carriage lifts and raises the pipe off the floor. If the carriage is placed near the center of the length of pipe the load will be nearly balanced and the pipe may be easily wheeled to destination by guiding and pushing from one end.

M. A. Saller.

How I Get the Best Out of a Trade Paper

Many people say to me, "Why do you take such and such a paper?"

My answers to such questions are generally in substance as follows:

First. Go over and read the advertisements, making notes of new and interesting articles. At the same time, cut out all good detail pictures of things I am interested in or likely to be. I place these in a scrap book according to their classification.

Second. Read over the index, making notes of articles that particularly interest me.

Third. Read editorial.

Fourth. Read articles, marking in pencil the information which interests me, also checking off the titles of the articles. Then go over article and note these points, either in loose leaf book or general file.

Fifth. Read over question and answer page, if any, checking up question with my own ideas. If I haven't any, I try to find out somewhere else and check up.

Sixth. Read over new construction, and new apparatus, as given in their respective sections.

Seventh. If paper gives a list of new patents, read them over.

Eighth. Read over the position vacant and position wanted section. Make notes from here regarding salary, service and jobs. This keeps you lined up with others and gives you a check upon yourself to see if you are becoming stale.

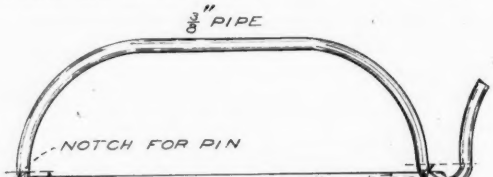
While this may sound long-winded, it does not take long to get the habit, and once you get it, enough said. If a formula should be given regarding some work, I immediately try it against some of my old ones and if it is simpler and easier to solve, it goes to my working list. Another point I get out of the advertisements and sometimes out of the reading matter is new books. I investigate the libraries and see if they have them; if not, I make a suggestion to the one in charge and generally they get the book. After I am through with the magazine, I take the advertisements out and leave the body of the magazine in my bookcase. I bind, or have someone bind them for me. When I bind them, I use heavy paper for covers and mark on the edge and front the magazine name, the volume, number and sub number, the page number and the year. This enables me to pick out instantly any magazine to which I may have reference, or if I am reading a magazine and a note is made referring to another volume, I can get it right off. Perhaps you may argue that this is too much time wasted, but even so, I have found it to pay mighty good returns. I can honestly recommend this scheme to any person who wishes to get ahead and stay ahead.

Dean B. Cobb.

Amusement (For Engineers); A Hacksaw Frame

Here is some "information" that was printed in the Information Bureau of my evening paper:

"In advertisements of electric machinery it is sometimes described as K-VA instead of K. W. For instance, what does 675 K-VA mean?



HOME-MADE HACKSAW FRAME

"Answer—The phrase 675 K-VA means 675 kilometers per one thousand volt amperes."

Can you beat it?

It is my custom always to require a receipt from

anybody who borrows tools from me. It saves me considerable inconvenience at times and has a good moral effect upon the borrower who is usually prompt in returning the tool.

My fireman, however, evidently has a more legal turn of mind than myself as indicated by the following promissory note which he required a borrower to sign during my absence: "I hereby agree to return this wrench." The evidence, however, was somewhat at fault for I was a long time finding out which wrench had been loaned.

The sketch herewith shows how one of our men made a frame for a hacksaw out of ⅜-in. pipe.

V. O. SAFRANEK.

Induction Motor Driving

THE SKETCH herewith shows the wiring diagram of a standard induction motor applied to a factory freight

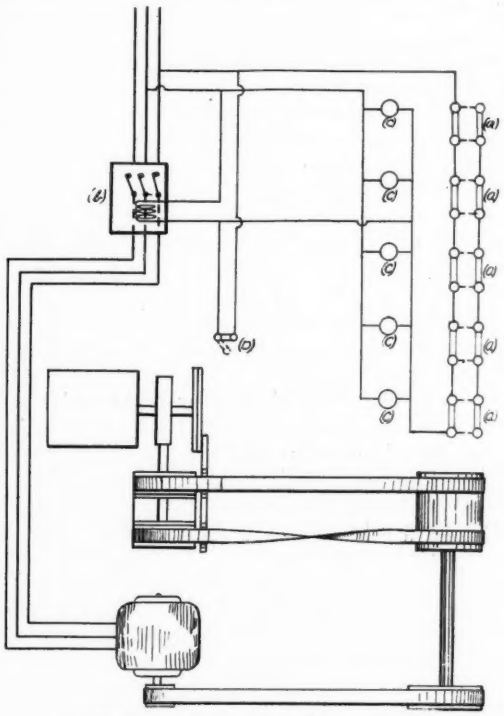


DIAGRAM OF ELEVATOR MOTOR CIRCUIT

elevator. The motor runs a counter-shaft from which the elevator machine is driven by a straight and crossed belt in the usual manner.

In operation, the operator first turns one of the snap switches (a), which energizes the magnet of the self-starter (b) and the motor comes up to speed. At the same time, the pilot lamps (c), on each floor light up indicating that the motor is running. As the motor has no load, it accelerates very rapidly and the car may then be operated by the shipper rope as usual. After the landing has been made, the operator snaps the stop button and the motor stops. The switch (d), is closed by the belt shifting mechanism. It short-circuits the control switches and prevents the possibility of the motor being stopped except when both belts are on the loose pulleys of the elevator machine.

BURT N. EVERETT.

Blowing Down Boilers

IN THE July 15 issue, H. Armstrong comments on the advice from engineers about blowing down boilers. The writer has read and heard numerous opinions as to the proper time, with consequent effects, of blowing down boilers, with also quite an assortment of ideas. The writer has the firemen gradually open each blowoff till wide open for about one minute every morning before starting up. I do not venture to say that more dirt and sediment is blown out, as we all should know.

When the blowoff is open, the water has a swirling action from the surface down to the open blowoff pipe, which offsets the theory that the circulation has any marked effect along the bottom of the boiler, tending to remove any great amount of sediment that accumulates at the bottom of the boiler.

On opening up the boilers, I have often found a hill of scale and sediment surrounding the opening to the blowoff pipe inside the boiler, which would verify my contention that the water has a swirling downward action while the blowoff is open. For instance, if a tank has several vertical pipes taken from the bottom of the tank, each pipe of like diameter, but of different lengths, the longest pipe will empty the tank sooner than any of the others, due to the fact that there is more head of water acting on the orifice, hence this same relation holds true in blowing down boilers; the head of water is acting downward, therefore it is well to change the water in the boiler and keep the blowoff clear by opening it at regular intervals. But don't depend on the blowoff to keep the boiler clean.

JAMES G. SHERIDAN.

Power for Argand Blower

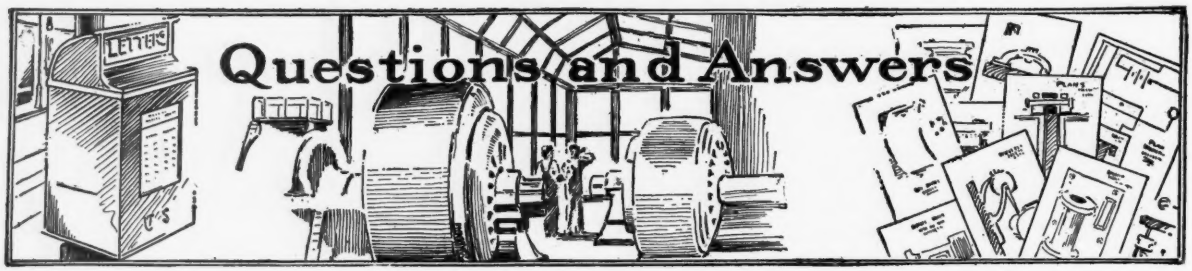
ON PAGE 572 of the July 15 issue, the following statement appears: "I think that it is an accepted fact that such blowers take for operation about 10 per cent of the steam generated."

This refers to Argand steam blowers for forced draft, but I have used the genuine Argand blower for 8 yr., and one of my boilers is fitted for testing purposes. While this boiler was developing 134 hp. for 10 hr., the blower took 3 hp., which is about 2½ per cent.

W. H. WAKEMAN.

U. S. CIVIL SERVICE COMMISSION announces an examination, Sept. 17, for junior explosives engineer, entrance salaries ranging from $1200 to $1500. Competitors will be rated on education, experience, and a thesis, to be filed with application. Applicants must have graduated from a full 4 yr. high school course or completed 14 units of high school work accepted for college entrance. In addition, they must have completed at least 3 yr. of a course in chemistry, mining, or metallurgy, in a college or university with the completion of at least 90 credit hours. They must have reached their twentieth but not their fortieth birthday on the date of the examination. Apply for Form 2118, stating the title of the examination, to the Civil Service Commission, Washington, D. C.

TO ACHIEVE victory we must have two armies: One that fights; one that saves. Every patriot will be a member of one of these armies.



Cleaning Two-Inch Pipe; Gasket Trouble

I WOULD LIKE to be informed of a way to clean a 2-in. pipe that was formerly used to convey fuel oil for a mile from the railroad to the cannery recently taken over by the Haiku Fruit & Packing Co. A little over a year ago, I had occasion to move our oil tank and I had a few lengths of 4-in. pipe left after the work was finished. I burnt the oil out by adding a little distillate and I got a very clean job, using the pipe later as an exhaust pipe from the engines to our new 300-hp. Blake-Knowles open feed water heater.

I have tried the same idea on this 2-in. pipe, but find it cannot be done as the fire goes out within a foot of the end. Do you think that, by standing the pipe on end and making a brick furnace, using it as a smokestack, I can burn it out? Perhaps you can suggest some chemical that will do the work and yet not be so poisonous that I could not use it for water later.

Perhaps the readers of Power Plant Engineering can suggest some way out of our troubles with the breaking of gaskets on the engines of a four-speed 1½-t. Federal truck. Owing to the World War, we engineers in the Islands are finding it more difficult each month to secure supplies and as a result we are seriously inconvenienced by not being able to secure copper gaskets.

Upon trying nearly every packing we could secure on this Island, we finally secured some 1/32 Johns-Manville Permanite sheet packing and made our gaskets, and upon putting the cylinder caps in place we took a strand out of "Helios Strand" ⅜ Crandall valve stem packing and placed it in the shoulder and since doing this we have had but one gasket break. About three weeks ago our ¾-t. Republic truck broke the copper cylinder head gasket, and being unable to secure any gaskets in Honolulu, we have used the 1/32 packing without a break since.

Do you believe I could make a copper gasket asbestos lined without the aid of a machine, provided I could secure the soft sheet copper and sheet asbestos? What I thought of doing was to make a screw press for binding the sheets together, as the cylinder head gaskets are only 6 in. in diameter.

S. E. S.

Stack Design and Construction

WE HAVE an iron smokestack which we wish to replace with one of brick and will thank you for any information you may give us as an aid in erecting this stack with local first-class brick masons.

Our present stack is mounted on a square base of brick which we intend to remove. The base is 15 ft. high and the stack itself is 48 in. in diameter, 60 ft. high and is made of No. 8 iron; it serves one 72-in. return tubular boiler having 74 4-in. by 18-ft. tubes and 36 sq. ft. of grate surface. The breeching is 45 in. in diameter.

We wish to put up a brick stack to secure the same good results, or, of course, better if possible.

C. L. R.

A. The question of designing a smokestack or chimney is one that requires considerable thought and study, and also considerable knowledge of location and operating conditions. While there are rules and formulas accurate to a certain extent, yet this accuracy has been brought about by years of experience and a comparison of results, so that stacks, especially of large size that are high enough to rise above surrounding buildings or hills, can be calculated within a close margin as to possible performance. The small stack has certain limitations that must be taken into consideration, the principal one of which is height; and this being true, it not infrequently happens that the stack gives poor results on account of conditions entirely outside of the stack itself. Then the quality and quantity of fuel is another matter that has a great bearing on stack conditions, as slack requires a much greater draft than ordinary lump coal and this quite a little more than wood. But to be on the safe side, it is better to have a stack of sufficient capacity to take care of the most adverse conditions that might arise, for if you have too much draft it can be controlled to meet existing conditions, while if your draft is poor, there is no way to remedy it without considerable expense.

Your boiler is approximately 150 hp., as boilers go. We might go into complicated formulas covering difference of temperature between the flue gases and the outside air for a wide range of temperatures, and arrive at a theoretical conclusion which would meet your requirements, and include stacks of different heights and diameters, for this boiler only. But as this problem has been thrashed out by engineers and manufacturers, certain tables have been prepared and are now accepted as standard for all ordinary purposes, and we find that your stack, which is 48 in. in diameter by 60 ft. high, is about 215 hp., and that one that would probably take care of your boiler in a most satisfactory manner would have to be about 38 in. in diameter by about 70 ft. high.

When the necessary height has been secured to carry the escaping gases above the surrounding buildings (which we imagine would be very necessary in your case), it is a waste of money to build higher; rather increase the diameter if necessary to secure capacity. A well-designed brick stack should have a base not less than 1/10 the height in diameter, which in the present instance would mean 7 ft. The foundation under the stack must be prepared with great care and must be of sufficient

area to prevent settling. If the soil is solid, such as clay or gravel, use a base about 11 ft. in diameter and carry it about 5 ft. below the level of the ground.

If the soil is soft or on filled-in ground, a large area will be required. If the foundation is on rock or shale that has an inclined surface, see that this is removed so that the foundation will rest on a level base.

A brick stack is designed from the top, in sections of about 20 to 25 ft., and each succeeding section will necessarily have to be strong enough to carry all that is above it both as to weight and wind pressure. The last 25 ft. at the top is one brick (say, 8 in.) in thickness, and each succeeding section should be half a brick thicker. In the present instance the second section of 25 ft. would be 12 in. thick and the lower section of 20 ft. 16 or 17 in. thick.

This would leave the actual internal diameter of the stack itself 50 in., inside of which there will be a firebrick lining 38 to 40 in. inside diameter extending upward about half the height of the stack, with an air space between the lining and the stack. This lining should not be tied to the steel stack proper, but at the top it can be corbeled out to meet the general alinement of the inside of the upper sections.

A suitable cleanout door should be built into the base of the stack and a hole at the proper height to receive the breeching. Rather than have the breeching butt into the stack square, have it incline upward the last 4 ft. or so on an angle of about 30 deg. with the horizontal; this gives the gases an easy passage from the breeching to the stack.

The question of an ornamented top is simply a matter of taste, but the general practice is to eliminate most of the elaborate architectural features in vogue 25 or more years ago. A plain stack—that is, one perfectly straight on the outside without any attempt to relieve the monotony of the exterior—will carry off the gases and give as good service and last as long, maybe longer, than one on which the mason incorporated a few original ideas of beauty.

A good method and one generally followed today, is to start to corbel out about 25 courses from the top, gradually at first, until the external diameter is about 8 in. more than normal, and after laying three courses straight, draw in more rapidly towards the top, and cover the top of the stack either with circular vitrified tile, cast iron plates in sections bolted together, or with good cement, well rounded off.

The mortar used should be good lime mortar with clean, sharp sand and tempered with good Portland cement. The firebrick lining, of course, should be laid in fire clay. Plastic cement might be used, of course, but while it is excellent for fireboxes, etc., its use in connection with stacks has been limited. The amount required depends on how the manufacturer packs it, whether in barrels or bags, and there is a difference as to the quantity required of the several brands to cover a given surface. Manufacturers of this material who advertise in Power Plant Engineering will be glad to inform you regarding their goods.

A lightning rod is a good thing on a stack and is a good investment even at the present price of copper and platinum. The best rod is a strip of copper about 1/8 by ¾ in. in cross section fastened to the stack by suitable hooks, preferably built into the wall when the stack is first built. For a small stack, two points will be ample and these should be tipped with platinum. These tips will withstand the corrosive effect of the hot gases and will withstand the action of the bolt of lightning better than any other metal.

The base of the rod should be carried to a depth where the soil is always wet, and there coiled or spread in such manner as to insure good contact between rod and soil. G. H. WALLACE.

Care of Oil-Cooled Transformers

HOW OFTEN should the oil in service transformers be changed?

Does the oil when dirty have a tendency to lower the efficiency of the transformer? V. K. S.

A. Presence of dirt in transformer oil will have a tendency to reduce the efficiency of the transformer, first, by interference with the proper circulation of the oil, and second, by the deposit of such dirt upon the outside of the coils, both of which would tend to reduce the proper dissipation of the heat.

Of course, it would be only when an excessive amount of dirt is present, that the efficiency would be reduced materially.

The frequency of change of transformer oil depends entirely upon local conditions, and it requires the use of one's good judgment as to when the oil is of no further good use.

One of the worst things to contend with in the operation of oil-cooled transformers is the presence of water in the oil, and high voltage transformers should be tested at least once a month for this purpose, and if its strength is below par, it should be dehydrated. The best method for doing this is by the use of a filter press dehydrater, such as manufactured by the General Electric Co. or the Westinghouse Electric & Manufacturing Co. In this type, the oil is pumped through several thicknesses of blotting paper. When using this apparatus, it should be seen that the paper is carefully dried, and it is better to soak it, first of all, in clean oil that is perfectly dry.

When the oil is in very bad condition the paper should be changed, from time to time, as often as found necessary.

Turbine vs. Reciprocating Pumps

I SHOULD much appreciate it if you would give me your opinion concerning the relative advantages and disadvantages of the turbine type of feed-water pump as compared with the reciprocating plunger type, also the relative advantages and disadvantages of using a direct-connected motor drive as compared with a steam turbine with reduction gearing.

2. What is your opinion of feed water economizers as a means of using part of the heat of the flue gases? There has been some doubt in my mind as to whether the advantages gained were not offset by the hindrance to the effective draft caused by the introduction of the economizer. C. C. F.

ANSWERS

THE TURBINE feed-water pump has the advantage of steadier flow of water, generally better economy—that is,

lower power consumption—than the reciprocating pump for a given amount of water pumped, and can be used more readily for drive from the steam turbine or the electric motor.

On the other hand, the reciprocating pump is more flexible—that is, the speed can be more readily regulated, and the amount of flow from the pump to the boiler more readily controlled. It is a slow-speed rather than a high-speed machine, hence requires less attention, and perhaps has slightly less depreciation, although this is a point which might be questioned.

2. As to the drive for a centrifugal feed-water pump by motor or steam turbine, this depends largely on plant conditions. If the pump is fairly large size, and the exhaust steam from the turbine—which in this case would probably be small, separate turbine with atmospheric exhaust—is needed for feed water heating, the turbine will probably be the cheaper device, both as to first cost and operation.

If, on the other hand, the pump is medium or small size, and there is all the steam necessary for heating the feed water from other sources, the electric motor will be a cheaper method of driving, since its energy will be generated by the main turbine, and the speed of the motor can, furthermore, be more readily controlled for varying the rate of speed to the boiler than can the speed of the steam turbine.

Increasing Amount of Water for Can Filling

I AM OPERATING a 35-ton ice making can plant and am turning out 36 tons per 24 hr. I could make more, but I cannot get condensed water enough from the engines. I have a deep well pump for the condenser, condensing water at 50 deg. F. I have run a 3/8-in. pipe line from this pump to the exhaust headers just as it enters the steam condenser and am using some raw water from this line. Will this make cloudy ice?

Is there any other way that I can get more water for ice making? W. N.

A. The injection of raw water into the exhaust steam at a point just before the steam condenser is a good way to increase the amount of water for can filling.

In some parts of the country the raw water so used will cause a heavy white core, if not whiten the whole cake of ice. In some places the raw water can be used without harming the appearance of the ice.

When it is considered what a very small per cent of raw water is necessary to add a few more tons to a 35-ton plant, it will be plainly noticed that but little need be injected if the injection is continuous during the whole 24 hr.

For a tryout, I would suggest the following: In the exhaust line (close to the steam condenser) insert a piece of 3/8-in. pipe not less than 5 ft. long. Put a cap on the end and drill four holes 1/16 in. in diameter through the sides of the cap. Also drill the same number and size holes at points 6 and 12 in. from the cap. This gives 12 small holes for the water to spray through.

The 3/8-in. pipe must be inserted by means of a long threaded nipple and a bushing.

The raw water used should come from the boiler feed pump, as the greater part of the sediment has been deposited on the outside of the steam condenser and in the feed-water heater.

In the passage of the hot water through the 5 ft. of pipe surrounded by steam whatever hardness remaining is removed and the small streams mix readily with the steam as it enters the condenser. This mixed water should be boiled violently in the reboiler.

If this scheme is to be used it should first be tested for a few hours, as by so doing only a few cakes of ice will be spoiled in case the raw water is not fit to be so used.

Additional steam condensers and the use of live steam direct from the boilers is a sure way of obtaining more distilled water, but the cost is great. Keep the outside surfaces of the condensers free of scale and use as much and as cold water as possible. A. G. SOLOMON.

Air Space in Boiler Setting

WE ARE about to install three horizontal 150-hp. return tubular boilers. The engineer in charge showed the writer prints with detail of brick work, which call for a solid brick wall, thereby eliminating the air space between the inner and outer walls, claiming this method of setting boilers, with air spaces had been discontinued by all large companies 5 or 6 yr. ago.

Will you please advise whether the statement made by the engineer is correct? If so, how is expansion taken care of in brick in the inner wall?

S. E. R.

A. It has been determined by the Bureau of Mines that the air space in a brick wall is not of help, so far as the conduction of heat is concerned, and a solid brick wall is better. For a wall between boiler settings, we doubt if there is, except for a short time while the boilers are starting up, enough difference in temperature between the inside and outside of the wall to cause any expansion trouble; but if there is any doubt on this point, a 2 or 3-in. space might be left in the interior of the wall and filled solid with sand, which will prevent air circulation in this space.

Loss of Power Due to Vacuum Drop

IF MY VACUUM drops from 22 to 15 in., what will be the corresponding reduction in power? O. A. B.

A. The amount that the reduction of your vacuum from 22 in. to 15 in. will reduce the power depends on the conditions under which the engine is running. Twenty-two inches is the equivalent of 7.97 lb. absolute pressure, and 15 in. is the equivalent of 14.95 lb. absolute; so that this reduction is practically equivalent to increasing the back pressure in the low-pressure cylinder 7 lb. This will reduce the mean effective pressure in that cylinder by the same amount. Of course, in actual practice, the high-pressure cutoff will be increased by the governor enough to take care of this loss in power, but that will be at the expense of an increased use in steam.

The simplest way to treat this problem is considering all power to be developed in the low-pressure cylinder. Then the mean effective pressure will be equal to a constant times the initial pressure, in pounds absolute, times (1 + hyperbolic logarithm of r); the whole divided by r, and from the quotient subtract the back pressure.

In this case, 3 is the total ratio of expansion in the two cylinders, and is found by dividing the initial pressure by the pressure exhaust opening in the low-pressure

cylinder. The constant is a value to take care of the loss in pressure, due to drop between the two cylinders and the rounding off of the card at the corners, and will vary from 0.75 for an engine having a big drop between cylinders and the corners a good deal rounded, to 0.9 for an engine having little drop and where the corners are nearly square.

If you can give us the figures on your engine, we shall be glad to try to work out exactly for you the loss in power in your engine. We would need the initial pressure, cutoff in the high-pressure cylinder, the diameter and stroke of high and low-pressure cylinders, receiver pressure, and the point of exhaust closure in each cylinder, or the pressure at the end of compression in each cylinder.

Muffling Oil Engine Exhaust

How would you suggest muffling the exhaust of an oil engine?

We have a 4-in. line exhausting into the open and I am desirous of knowing whether by building a concrete cistern with a 12-in. stack I could eliminate some of the noise now taking place without a loss of power.

E. C. V.

A. The concrete tank which you propose is probably as good a method as any of muffling the exhaust from your oil engine. The principle of muffling such an exhaust is the attaching of some device to the end of the exhaust pipe, which permits a gradual expansion of the gases instead of the sudden expansion which comes when the gases are released at once from the end of the pipe.

Attaching a chamber to the end of the pipe, such as a piece of 10-in. pipe a couple of feet long, and providing a 4-in. outlet from the end of this, will reduce the noise considerably; but if this device be placed inside the concrete pit, and a 12-in. stack provided for carrying away the gases, it will work even better. Such a device would add very little to the back pressure.

Heating Coil Calculations

How many gallons of water will a coil of 100 lineal feet of 1-in. copper or brass tubing heat per hour when surrounded by a temperature of 500 deg. F. heat temperature of water entering the coil to be 50 deg. F. and discharged at 150 deg. F.; the tubing is to be of sufficient thickness to withstand a water pressure of 70 lb. per square inch.

Is there any rule or table for computing the number of gallons of water copper, brass or iron pipe will heat to a required temperature when the sizes and other temperatures are known? G. P. M.

A. The method of finding the gallons per hour that can be heated under your conditions would be to multiply the area, in square feet, of the exterior of your heating coil by the average temperature difference between the water and the gases, and by a constant; divide this by 8.33, the pounds of water per gallon, and by the temperature rise of the water.

For 1-in. pipe, the length of 2.9 ft. will give a square foot of external surface, so that 100 ft. will give about 34 sq. ft. The average temperature of the water is 100 deg. F., and the difference between this and 500 will give 400 deg. temperature difference.

The constant for copper or brass pipe would be about 250, and the temperature rise of the water is 100 deg. Using these values, it would figure out to about 4000 gal. of water an hour which would be heated by 100 ft. of copper pipe.

The thickness of the pipe would make very little difference, as the chief resistance to the conduction of heat is at the surface of the pipe. For wrought iron or steel pipe, the constant will be practically 200.

Card Criticism

In July 15 issue, page 592, E. N. asked for criticism of a card taken from an 18 36-in. Hamilton Corliss engine running at 950 r.p.m.

Presuming this to be a single eccentric engine, the valve setting is very good, but a trifle late all around.

The admission line indicating some piston travel before the valve is entirely open and the sled runner effect at the end of the stroke shows late opening of exhaust valve of the wristplate and valve rods are properly adjusted. This can be corrected by moving the eccentric ahead.

The right-hand diagram is a little strong. Before making any changes on the valve setting, he should examine the cylinder and rings, as the steam line shows a leak.

This, if bad enough, would mislead one into thinking the valve setting was late. G. D. W.

In criticism of the indicator card submitted by E. N. and published on page 592 of the July 15 issue, I would state that the card is not bad. The admission line leans in on both ends, but a little admission will straighten this out. The exhaust valve on the head end should open earlier. With earlier admission the cutoff will be sharper. If you will give the crank end more lead than the head end, the load will be more evenly divided, as the head end is now doing most of the work.

Frank Wells.

The diagrams submitted by E. N. show the admission to be a little late. There seems to be wiredrawing as the steam line falls slightly, which might be due to the steam pipe being too long or too small or having too many elbows.

He should advance the eccentric a little, which will also help the steam line as well as the admission line and he can equalize the cutoff with the governor rods. As the area of the piston rod is taken from the area of the piston on the crank end, it might be well to have the mean effective pressure a little higher.

Perry Bartram.

Every time you stick a Thrift or War Savings Stamp on your card you are mailing money to yourself to be received later with interest. Cashing in these stamps is going to be better than "getting money from home," for with the money comes the reminder that you contributed to the great victory which then will have been completely won.

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Centralizing Power Generation

"Will my plant be shut down?"

That is the question in which every engineer is vitally interested, and it seemed necessary to get an authoritative statement as to the policy of the Fuel Administration. Their reply to the request of Power Plant Engineering for such a statement is given in the first two pages of this issue.

It shows an intent to deal fairly with each case on its own merits, keeping in view the fact that saving coal so as to relieve the fuel situation so far as possible for all the people is of more importance than the preferences or even the necessities of any one plant.

Many engineers in charge of individual plants of moderate and small size, which use exhaust steam for heating in winter and cannot run condensing in summer because of lack of cooling water, have realized that, during the non-heating months, it would be good economy to use central station current if a reasonable rate could be obtained. Many, perhaps the majority of the central stations have, in the past, taken a position that they would have all or nothing, and have demanded a rate so high for summer connection that it put use of their current for summer load alone out of the question. And the use of exhaust steam for heating during the winter gave so great an advantage over central station power and low pressure live steam that wise plant owners accepted the summer loss for the sake of the winter gain.

Of late, there has been a notable change in the attitude of some central station managers; they have come to see that what is best for the community is best for them. They can carry the summer connections at a time when much of their installed capacity is idle, at a reasonable rate and make a profit. And they are realizing that the autocratic idea of rule or ruin is not in harmony with the growing sentiment, that a public utility corporation is primarily created to serve the public.

There are yet many who cling to the old formula and wish to wipe out all individual plants. Such may be assisted to see the light by a few decisions of the Fuel Administration that they must furnish current at reasonable rates during the summer season only to plants that can generate their own power with good coal economy during the winter.

The job of the Fuel Administration is to save coal. If this can best be done by throwing the load of a wasteful small plant onto central station lines, it is the right thing for them to do. If an economical but underloaded individual plant can well supply current to an overloaded central station, even to the extent of shutting down uneconomical units in the central station, that should be done. If several individual plants can be tied together to good advantage, because of difference in peak load time and low load time, so that a better load factor may be secured, and part of the plants be shut down during low load periods, it is good engineering and good sense to order it done.

If a plant, either individual or central station, is wasteful, and the condition cannot be or is not remedied, it is in the interest of the country that its power load

be thrown upon the most available plant which is showing good economy. And the Fuel Administration is justified in using its powers for the best interests of the community in all cases.

But any attempt to coerce the individual plant to become a user of central station current, unless it is clearly evident that fuel will thereby be saved is, of course, unwarranted, and to be condemned. The Administration goes on record that it does not intend to favor any interests, and that such orders as it may issue will be only for the period of the war, will involve no dismantling of plants, and will leave the plant owner free to decide his own course after the war is over, subject to such governmental regulations as may then be made.

Of course, some mistakes will be made. That is inevitable in as big an undertaking as regulating the power plants of the entire country. But so long as the Administration shows a readiness to give a rehearing on any decision that is questioned, and to reverse itself when the evidence shows that there is a mistake, the Administration officials should have the support of the power plant industry. Mistakes should, of course, be pointed out and constructive criticism is the right of every American citizen. But this is not inconsistent with a general policy of aiding the work of Administration officials where this is evidently good.

Interconnecting of hydraulic and coal-burning generating plants, so that full capacity of the hydraulic plants may be utilized at all times, is evidently a feasible plan of coal saving. Every horsepower-hour wasted over a dam, while coal is being burned to generate steam power, is poor economy, if there is a possibility of so connecting the stations that the water power can be saved. Jealousies of power companies and differences as to how to adjust payment are of little consequence beside the saving of some tons of coal which may mean next winter the difference between comfort and misery to several families.

An example is the proposed connection of the Sanitary District lines of Cook Co., Ill., to those of the Commonwealth-Edison Co., of Chicago. Surplus current from the Sanitary plant can thus be made available for supplying Chicago buildings and small industries for which coal would otherwise be burned. The Sanitary District plant cannot supply all the power needed, and it would be foolish to order a general shutting down of the plants in the loop, particularly as even in summer many of them must have steam for elevator and other pumps. But if good engineering sense is used, and each case decided on its merits, a considerable saving of fuel can be effected, with no inconvenience to power users.

If any central stations show a disposition to take advantage of the situation by attempting to impose unreasonable rates or conditions on those users which the recommendations of the Fuel Administration bring as customers, it is to be hoped, and from the attitude of the Administration, expected that the central station companies will be disciplined as quickly and severely as the owners of individual plants who refuse to adopt suggestions for improving fuel economy. Any other course would savor of partisanship, and would be worthy of censure.

Enforcing economy in the use of coal is part of the job of the Fuel Administration. So long as it is done without fear or favor, nobody has any cause for complaint.

We are in a war. The most important job on hand is to win. Fuel is one of the essentials to success, and we need all and more than we can produce. Hence, fuel must be saved in every possible way, and such combining of plants, centralizing of power generation and distribution, and evening up of load factor as will contribute to that end are as much war work as making guns, raising wheat or buying Liberty Bonds. In fact it will help all three, for it will save fuel for munition plants, save labor to help cultivate the farms, and save money to invest in Bonds.

Back up the Administration in its efforts, and if mistakes seem to be made, give the officials credit for sincerity of purpose unless there is unmistakable evidence to the contrary.

Ship Records

FASTER AND faster the men in the yards are working to make the submarine threat futile. On July 4, the Defiance was launched at Alameda, Cal. Within 5 sec. the first keel plate of a new boat, the Invincible, of 12,000 tons, was laid, and before evening the vertical was in place. The pace has kept up, and in twenty-four working days the ship was completed and was launched on Aug. 4.

At Ecorse, Mich., a 3500-ton steel boat was completed in 14 days from laying of keel to launching.

And so it goes. New records are being made every week. The great need now is that men in the shops where boilers, engines, turbines and other equipment for these ships are being manufactured should catch the same spirit of eager enthusiasm to help win the war. Output can be increased, probably doubled, if all the men in the shops, like the men in the yards, "go to it" in the day's work as if they were charging a Hun battalion, face to face. Not your "bit"—your Best, is what will help win the war. Up and at 'em.

Giving the New Employe a Welcome

WHEN YOU go into a country or a strange place you are grateful to the man who extends to you the hand of fellowship, to the one who makes you feel at home.

Remember the new employes on the job. They are strangers within our gates. Especially at this time when we are increasing our force are we afforded an opportunity of showing new employes that we are interested in them and that we are anxious for them to be satisfied.

In case the newcomers are foreigners, there is even greater obligation to make them feel welcome.

It is the privilege of every American at this time to make the strangers from other lands feel that we appreciate their help in winning this war.

Treat them with the same courtesy and kindness that you would desire if *you* were a stranger in a foreign country.

Your personal contact with foreign fellow workers can help to unite all races in America to win this war.

Sealflex Arches

CAPACITY is one of the big problems in present day boiler plants. As production is forced, the load increases, but new boilers are hard to get, and costly. Hence, any method of increasing the capacity of boilers now in the plant is of interest. And capacity depends on two things, ability to burn coal and to absorb heat.

Burning coal depends on good draft, proper air supply and mixture and maintaining high temperature. To insure the last a long flat arch is recommended by the Green Engineering Co., which has designed the Sealflex arch for this purpose, the arrangement being as shown in Fig. 1.

At the front is a hanging curtain of tile which forces the air entering above the fuel bed down against the fire, causing it to be heated, to mix with the volatile gases, and thus preventing chilling of the arch surface. This curtain wall is grouted air tight to the front of the arch, so that no leakage at the joint is possible.

Support of the tile for the flat arch is as shown in Fig. 2. These tile, trade-marked "Geco," are the result of a careful investigation by ceramic engineers to determine the best clays, grinding, mixture and firing to produce tile that will stand up under the severe conditions imposed by an arch working under high combustion rates. The makers guarantee that all tile are carefully inspected and tested, and only perfect tile allowed to pass. The tongue and groove joint, and the outside recess for support, are two points for which especial advantage is claimed in increasing durability of the arch.

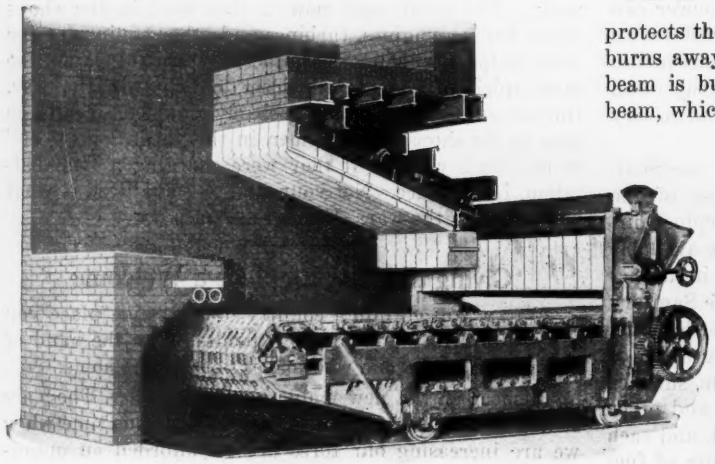


FIG. 1. CHAIN GRATE WITH "SEALFLEX" ARCH

As shown in Fig. 1, the back end tile are so shaped that they cover the ends of the supporting I beams. This protects the beams from burning, but in case an end tile burns away before it is noticed so that the end of an I beam is burned, a short removable end section of the beam, which is joined to the main beam by a clip, can be removed, and a new end put in place, without disturbing the main part of the beam.

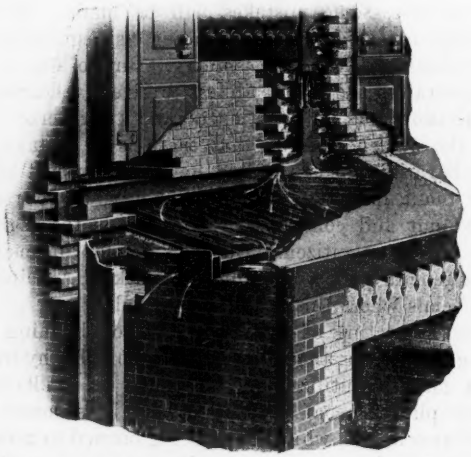


FIG. 3. VENTILATION SYSTEM OF "SEALFLEX" ARCH

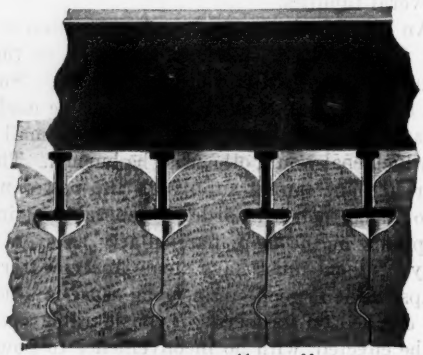


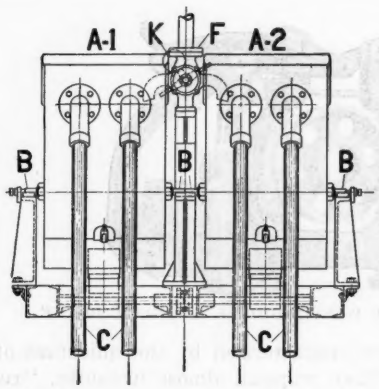
FIG. 2. METHODS OF SUPPORTING "GECO" TILE IN ARCH

Ventilation is provided to cool the top of the arch and supports, as shown in Fig. 3. A small flue, discharging into the stack, draws air between the arch and cover, thus preventing buckling and bending of the supports, and adding to the life of the arch tile.

These arches are designed for any style of setting, and installed by the Green Engineering Co., Chicago, Ill.

Leinert Automatic Gravity Scales

FOR actually weighing the water, the Leinert Automatic Gravity Scales, placed on the market by John Simmons Co., of New York, consist of two measuring tanks of equal size, A-1 and A-2, Fig. 1, each fitted at one end with one or more siphon pipes, C, and at the other with weights, D. Knife edge bearings, B, form the working pivots and are located at less distance from the counterweights, D, than from the siphon pipes. The liquid to be weighed flows through the inlet pipe, E, passing through valve, F, into either tank. Figure 1 shows the position of the valve when water is discharging into tank A-1. The weights, D, are so adjusted that the tanks will remain in a horizontal position until they contain a certain definite weight of liquid, then they will tilt into the position shown by the dotted lines in Fig. 2 and the liquid will begin to flow through the siphon pipe, C. After this flow has been started and the level of the liquid in the tank has fallen sufficiently, the tank tilts back again to its original position by the influence of the weights, D, the siphon continuing in action until the tank is emptied.



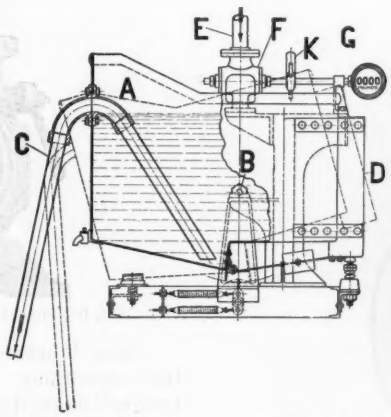


FIG. 1. LEINERT SCALES FROM DISCHARGE SIDE
FIG. 2. SECTIONAL VIEW OF LEINERT SCALES

As each tank assumes the position indicated by the dotted lines in Fig. 2, it suddenly tilts the valve, F, over, so that the liquid, instead of continuing to flow into the tank, A-1, begins to flow into the other tank, A-2, when the cycle of operations is repeated and continued. Thus both tanks are filled automatically with fresh liquid while the measured liquid flows away to a reservoir. As each tank tips the number of pounds is registered on the counter, G, which is actuated by the valve, F.

When either tank is in a horizontal position, the valve, F, rests on a support not touching the tanks, therefore the time of tripping and the accuracy cannot be affected either by the valve or by the pressure of the running liquid in the valve or by the resistance in the mechanism of the counter.

Tilting of the tanks and the recorded measurement are accomplished entirely by the introduction of a definite weight of liquid regardless of variations in specific gravity which might be caused by variations in temperature or quality of the liquid.

When the rate of flow varies considerably, slight inaccuracy may be encountered due to the varying quantity that falls into the tank during the time of the tank motion. For use under such conditions another type of meter has been developed in which at the moment of tipping but a small flow feeds the tank, the larger part of the stream being previously moved to the other tank by means of a float mechanism.

Standard Reflectors

THE Associated Manufacturers of Electrical Supplies, through their Reflector Committee, have been working for some months over the problem of setting and adopting standard dimensions and other specifications for porcelain enameled steel reflectors.

Difficulties attending this work were many and, inasmuch as the physical properties of reflectors are directly dependent upon lamp dimensions, the development of standardized reflector designs was carried on by joint meetings of the committees of both the reflector manufacturers and the engineering departments of the various lamp companies. These joint meetings were the result of appreciation by the reflector manufacturers, not only of the great advantages to be derived by the purchaser of standardized reflectors, but also the benefits derived by the lamp manufacturers on account of their interest in securing the best type of reflectors for their lamps.

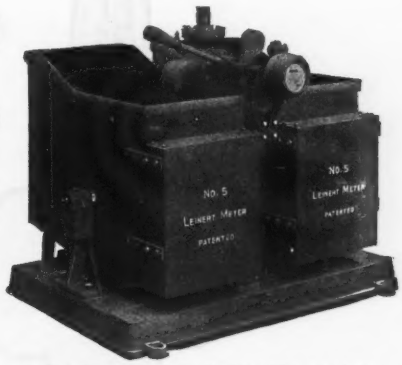


FIG. 3. FRONT VIEW OF LEINERT AUTOMATIC SCALES

As a result of these meetings, certain standard dimensions and specifications for dome reflectors were adopted by the reflector manufacturers. These manufacturers will, within a short time, place upon the market dome reflectors under the trade name or designation of R-L-M Standard, meaning Reflector and Lamp Manufacturers' Standard.

Entering into the discussion was a question of the character of the porcelain enamel surface. The outcome of this discussion was the adoption of a quality of enamel which is regarded as the most efficient for light purposes, considered from a standpoint of efficiency on one hand and elasticity and durability on the other.

The R-L-M Standard reflectors for the present will be confined to the dome types for direct lighting, and will be furnished in various sizes to receive lamps varying from 75 to 1000 w., inclusive.

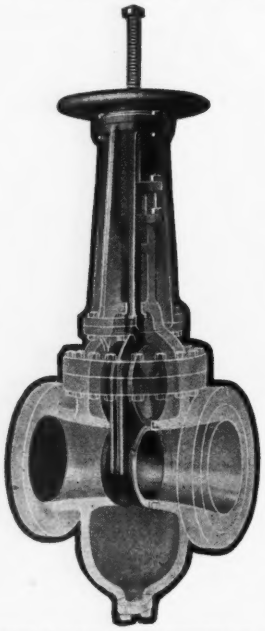
The adoption of these R-L-M Standard reflectors marks but the first step in the development of reflectors

by the committees. As conditions warrant, various other types of reflectors will be discussed, and certain standards adopted. As soon as the conclusions of the committees have reached a point where their findings are sufficiently exact to be adopted by the reflector manufacturers, and approved by the lamp manufacturers, such conclusions will be made public.

More detailed information concerning the R-L-M Standards will be published by the various reflector manufacturers individually through such channels as they themselves may select.

Cast Steel Gate Valves

A SERIES of valves designed especially for superheated steam at high pressures has been developed by The Chapman Valve Mfg. Co. of Indian Orchard, Mass. These have body and cap of cylindrical and semi-spherical design, giving a strong structure and



CHAPMAN DOUBLE DISC, STRAIGHTWAY GATE VALVE

uniform thickness of metal. Thus are secured even cooling when cast and close grain texture of the metal free from shrinkage strains.

Use of a straightway opening through the valve, the full size of the pipe line, removes all cause of back pressure and creates no eddies in the steam.

To increase the life and satisfactory service, discs and seats are protected, and the action is so designed that the discs revolve when opened or closed, thus compensating for wear and cleaning seats of obstruction. If by any chance the discs become scored, as they are of solid monel metal, they can be removed, resurfaced in a lathe, put back in the valve and are ready for service again.

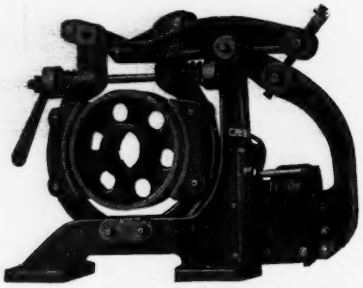
Seat rings and spindle seats are also cast of monel metal, and spindles are rolled of the same material. The cap has a seat of monel metal against which a collar on the spindle abuts when the valve is open, thus allowing the stuffing box to be packed while the valve is open and under full pressure.

Bodies and caps are of cast steel, the cap having a long neck, which assists radiation, thus lessening the heat that reaches the stuffing box, and lengthening the life of the packing. Six bosses are cast on the body, so that pipes can be tapped in from any desired direction for drops or bypass lines.

Parallel seats and double discs were adopted by the Chapman Co. as the answer to the increased difficulties resulting from higher working pressures, higher superheat and increased expansion and contraction. The discs, having free play, will seat regardless of distortion of the body caused by high temperature, and will always open and close easily. The valves can be arranged for distant operation by hydraulic or electric power, where conditions make it desirable.

Magnetic Brakes

THE principle of the type of magnet which has been so successfully incorporated in the design of magnetic controllers by the Westinghouse Electric & Manufacturing Co., has been employed by that company in a new design of magnetic brakes just developed for use with mill, crane and hoist motors.



APPLICATION OF WESTINGHOUSE MAGNETIC BRAKE

These brakes are characterized by the quickness of their operation. They respond almost instantly, "releasing" when the power is applied and "setting" when the power is cut off. This is due to the design of the operating magnet which gives high initial pull and a travel of from ¼ to 1 in.

When voltage is impressed on the motor, the magnet is energized and the magnet armature lever overcomes the pressure of the compression springs through a toggle and releases the brake-shoe grip upon the brake wheel. While the magnet remains energized the brake wheel is allowed to rotate freely. As soon as the current is shut off from the motor, the brake magnet releases and the compression springs force the shoes against the brake wheel and bring the motor quickly and smoothly to rest without shock or jar. The compression exerted by the springs can be easily adjusted so that any holding or retarding torque up to the full capacity of the brake can be obtained for equal braking effort for both directions of rotation. Simple means for making adjustment for shoe wear are provided.

In case adjustments for shoe wear should be neglected, a safety feature has been introduced so that the brake does not fail to hold the load but the magnet will not release the grip on the brake wheel. This insures proper brake operation and the elimination of accidents due to the slippage of the brake wheel.

These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should preserve them. A handy, serviceable, loose-leaf cover in which these tables fit exactly, will be sent you for 30 cents in currency or stamps.

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POWER PLANT ENGINEERING

COST PER HOUR OF CURRENT CONSUMED BY ELECTRICAL DEVICES

RATE PER KILOWATT HOUR IN CENTS

Watts Consumed	.01	.01½	.02	.02½	.03	.03½	.04	.04½	.05
1	.00001	.000015	.00002	.000025	.00003	.000035	.00004	.000045	.00005
2	.00002	.00003	.00004	.00005	.00006	.00007	.00008	.00009	.0001
3	.00003	.000045	.00006	.000075	.00009	.000105	.00012	.000135	.00015
4	.00004	.00006	.00008	.0001	.00012	.00014	.00016	.00018	.0002
5	.00005	.000075	.00010	.000125	.00015	.000175	.0002	.000225	.00025
6	.00006	.00009	.00012	.00015	.00018	.00021	.00024	.00027	.0003
7	.00007	.000105	.00014	.000175	.00021	.000245	.00028	.000315	.00035
8	.00008	.00012	.00016	.0002	.00024	.00028	.00032	.00036	.0004
9	.00009	.000135	.00018	.000225	.00027	.000315	.00036	.000405	.00045
10	.00010	.00015	.0002	.00025	.0003	.00035	.0004	.00045	.0005
11	.00011	.000165	.00022	.000275	.00033	.000385	.00044	.000495	.00055
12	.00012	.00018	.00024	.0003	.00036	.00042	.00048	.00054	.0006
13	.00013	.000195	.00026	.000325	.00039	.000455	.00052	.000585	.00065
14	.00014	.00021	.00028	.00035	.00042	.00049	.00056	.00063	.0007
15	.00015	.000225	.0003	.000375	.00045	.000525	.0006	.000675	.00075
16	.00016	.00024	.00032	.0004	.00048	.00056	.00064	.00072	.0008
17	.00017	.000255	.00034	.000425	.00051	.000595	.00068	.000765	.00085
18	.00018	.00027	.00036	.00045	.00054	.00063	.00072	.00081	.0009
19	.00019	.000285	.00038	.000475	.00057	.000665	.00076	.000855	.00095
20	.0002	.0003	.0004	.0005	.0006	.0007	.0008	.0009	.001
30	.0003	.00045	.0006	.00075	.0009	.00105	.0012	.00135	.0015
40	.0004	.0006	.0008	.001	.0012	.0014	.0016	.0018	.002
50	.0005	.00075	.001	.00125	.0015	.00175	.002	.00225	.0025
60	.0006	.0009	.0012	.0015	.0018	.0021	.0024	.0027	.003
70	.0007	.00105	.0014	.00175	.0021	.00245	.0028	.00315	.0035
80	.0008	.0012	.0016	.002	.0024	.0028	.0032	.0036	.004
90	.0009	.00135	.0018	.00225	.0027	.00315	.0036	.00405	.0045
100	.0010	.0015	.002	.0025	.003	.0035	.004	.0045	.005
200	.0020	.0030	.004	.005	.006	.007	.008	.009	.01
300	.0030	.0045	.006	.0075	.009	.0105	.012	.0135	.015
400	.0040	.006	.008	.01	.012	.014	.016	.018	.02
500	.0050	.0075	.01	.0125	.015	.0175	.02	.0225	.025
600	.0060	.009	.012	.015	.018	.021	.024	.027	.03
700	.0070	.0105	.014	.0175	.021	.0245	.028	.0315	.035
800	.0080	.012	.016	.02	.024	.028	.032	.036	.04
900	.0090	.0135	.018	.0225	.027	.0315	.036	.0405	.045
1000	.0100	.015	.02	.025	.03	.035	.04	.045	.05

POWER PLANT ENGINEERING

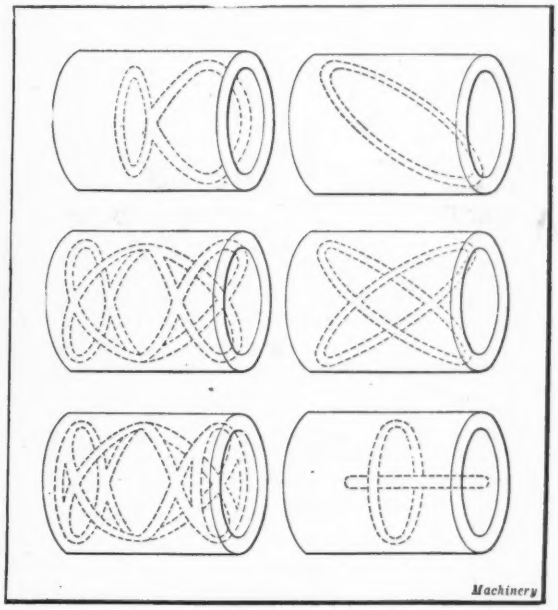
Wrought Iron, Steel, Copper and Brass Plates.

Birmingham Gauge.

No. of Gauge.	Thickness, Inches.	Weight Per Square Foot, Lbs.			
		Iron.	Steel.	Copper.	Brass.
0000	0.454 or 7/16 full	18.2167	18.4590	20.5602	19.4312
000	0.425	17.0531	17.2805	19.2525	18.1900
00	0.38 or ⅜ full	15.2475	15.4508	17.2140	16.2640
0	0.34 or ⅓ full	13.6425	13.8244	15.4020	14.5520
1	0.3	12.0375	12.1980	13.5900	12.8400
2	0.284	11.3955	11.5474	12.8652	12.1552
3	0.259 or ¼ full	10.9324	10.5309	11.7327	11.0852
4	0.238	9.5497	9.6771	10.7814	10.1864
5	0.22	8.8275	8.9452	9.9660	9.4160
6	0.203 or 1/5 full	8.1454	8.2540	9.1959	8.6884
7	0.18 or 3/16 light	7.2225	7.3188	8.1540	7.7040
8	0.165 or 1/6 light	6.6206	6.7089	7.4745	7.0620
9	0.148 or 1/7 full	5.9385	6.0177	6.7044	6.3344
10	0.134	5.3767	5.4484	6.0702	5.7352
11	0.12 or ⅛ light	4.8150	4.8792	5.4360	5.1360
12	0.109	4.3736	4.4319	4.9377	4.6652
13	0.095 or 1/10 light	3.8119	3.8627	4.3035	4.0660
14	0.083	3.3304	3.3748	3.7599	3.5524
15	0.072	2.8890	2.9275	3.2616	3.0816
16	0.065	2.6081	2.6429	2.9445	2.7820
17	0.058	2.3272	2.3583	2.6274	2.4824
18	0.049 or 1/20 light	1.9661	1.9923	2.2197	2.0972
19	0.042	1.6852	1.7077	1.9026	1.7976
20	0.035	1.4044	1.4231	1.5855	1.4980
21	0.032	1.2840	1.3011	1.4496	1.3696
22	0.028	1.1235	1.1385	1.2684	1.1984
23	0.025 or 1/40	1.0031	1.0165	1.1325	1.0700
24	0.022	0.8827	0.8945	0.9966	0.9416
25	0.02 or 1/50	0.8025	0.8132	0.9060	0.8560
26	0.018	0.7222	0.7319	0.8154	0.7704
27	0.016	0.6420	0.6506	0.7248	0.6848
28	0.014	0.5617	0.5692	0.6342	0.5992
29	0.013	0.5216	0.5286	0.5889	0.5564
30	0.012	0.4815	0.4879	0.5436	0.5136
31	0.001 or 1/100	0.4012	0.4066	0.4530	0.4280
32	0.009	0.3611	0.3659	0.4077	0.3852
33	0.008	0.3210	0.3253	0.3624	0.3424
34	0.007	0.2809	0.2846	0.3171	0.2996
35	0.005 or 1/200	0.2006	0.2033	0.2265	0.2140
36	0.004 or 1/250	0.1605	0.1626	0.1812	0.1712
	1.00 inch thick	41.5696	42.1236	46.9308	44.3408

POWER PLANT ENGINEERING

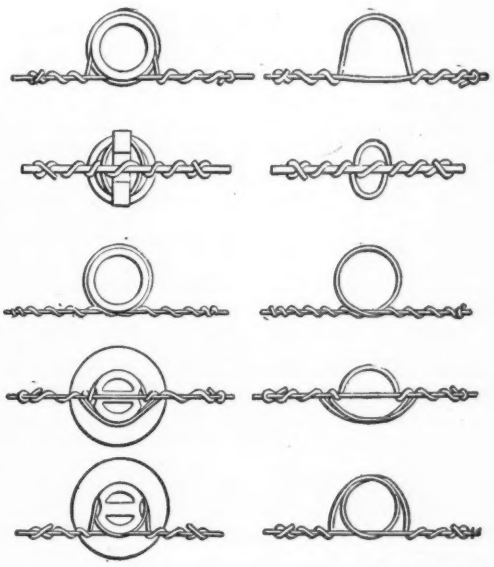
EXAMPLES OF BRONZE BEARINGS, SHOWING DIFFERENT FORMS OF OIL GROOVES



Machinery

POWER PLANT ENGINEERING

METHODS OF TYING USED WITH DIFFERENT INSULATORS



Electrical World.

TABLE 1. COMPOSITION OF ALLOYS USED FOR BEARING METALS

Alloys	Lead	Tin	Antimony	Copper	Zinc	Other Constituents
Babbitt 1	80.0	20.0	....	....	....	.....
Babbitt 2	72.0	21.0	7.0	....	....	.....
Babbitt 3	70.0	10.0	20.0	....	....	.....
Babbitt 4	80.5	11.5	7.5	0.5	....	.....
Babbitt 5	0.5	68.0	....	1.0	30.5	.....
Babbitt 6	....	20.0	....	....	80.0	.....
Babbitt 7	....	86.0	10.0	4.0	....	.....
White metal 1	82.0	....	12.0	6.0	....	.....
White metal 2	3.0	7.6	3.8	2.3	83.3	.....
White brass	....	64.0	....	2.0	34.0	.....
Bronze 1	11.5	11.5	....	77.0	....	.....
Bronze 2	15.0	8.0	....	76.2	....	P = 0.80
Bronze 3	9.5	10.0	....	80.5	....	.....
Bronze 4	....	3.0	....	97.0	....	.....
Bronze 5	....	15.0	....	85.0	....	.....
Bronze 6	15.0	7.0	....	78.0	....	.....
						Machinery

Note: P indicates phosphorus.

TABLE 2. ALLOWANCE FOR OIL BETWEEN SHAFT AND JOURNAL IN MEDIUM AND HIGH-SPEED BEARINGS

Diameter of Journal	Allowance	Diameter of Journal	Allowance	Diameter of Journal	Allowance
3/8 to 1	0.002	3⅝ to 4½	0.005	6	0.009
1⅛ to 2½	0.003	5	0.006	7	0.011
2⅝ to 3½	0.004	5½	0.007	8	0.012
					Machinery

SCHEDULE OF TIE WIRES FOR INSULATORS

Size of Line Wire (in Gage or In.)	Insulator	Top or Side	Tie Material	Tie Length (In.)	Type of Tie	Fig
COPPER						
6 or 4 w.p.	D.G.D.P.	Side	6 w.p.–m.h.d.	25	Western Union	1
2 w.p.	D.G.D.P.	Side	4 w.p.–m.h.d.	27	Western Union	1
1/0 to 4/0 w.p.	Cable	Top	4 w.p.–m.h.d.	36	Cross-top	2
1/0 to 4/0 w.p.	Cable	Side	4 w.p.–m.h.d.	30	Western Union	1
6 or 4 bare	D.G.D.P.	Side	6 bare ann.	27	Double	3
6 or 4 bare	11 kv.	Top	6 bare ann.	40	High-tension	4
2 bare	11 kv.	Top	4 bare ann.	40	High-tension	4
1/0 to 4/0 bare	11 kv.	Top	2 bare ann.	44	High-tension	4
6 to 4 bare	11 kv.	Side	6 bare ann.	40	Looped W.U.	5
2 bare	11 kv.	Side	4 bare ann.	40	Looped W.U.	5
1/0 to 4/0 bare	11 kv.	Side	2 bare ann.	48	Looped W.U.	5
STEEL						
¼ and 5/16	D.G.D.P.	Side	1 strand of 5/16 in.	27	Double	3
¼ and 5/16	11 kv.	Top	1 strand of 5/16 in.	44	High-tension	4
⅜	11 kv.	Top	1 strand of ⅜ in.	44	High-tension	4
¼ and 5/16	11 kv.	Side	1 strand of 5/16 in.	48	Looped W.U.	5
⅜	11 kv.	Side	1 strand of ⅜ in.	48	Looped W.U.	5

COST PER HOUR OF CURRENT CONSUMED BY ELECTRICAL DEVICES

Watts Consumed	RATE PER KILOWATT HOUR IN CENTS									
	.05½	.06	.06½	.07	.07½	.08	.08½	.09	.09½	.10
1	.000055	.00006	.000065	.00007	.000075	.00008	.000085	.00009	.000095	.0001
2	.00011	.00012	.00013	.00014	.00015	.00016	.00017	.00018	.00019	.0002
3	.000165	.00018	.000195	.00021	.000225	.00024	.000255	.00027	.000285	.0003
4	.00022	.00024	.00026	.00028	.0003	.00032	.00034	.00036	.00038	.0004
5	.000275	.0003	.000325	.00035	.000375	.0004	.000425	.00045	.000475	.0005
6	.00033	.00036	.00039	.00042	.00045	.00048	.00051	.00054	.00057	.0006
7	.000385	.00042	.000455	.00049	.000525	.00056	.000595	.00063	.000665	.0007
8	.00044	.00048	.00052	.00056	.0006	.00064	.00068	.00072	.00076	.0008
9	.000495	.00054	.000585	.00063	.000675	.00072	.000765	.00081	.000855	.0009
10	.00055	.0006	.00065	.0007	.00075	.0008	.00085	.0009	.00095	.001
11	.000605	.00066	.000715	.00077	.000825	.00088	.000935	.00099	.001045	.0011
12	.00066	.00072	.00078	.00084	.0009	.00096	.00102	.00108	.00114	.0012
13	.000715	.00078	.000845	.00091	.000975	.00104	.001105	.00117	.001235	.0013
14	.00077	.00084	.00091	.00098	.00105	.00112	.00119	.00126	.00133	.0014
15	.000825	.0009	.000975	.00105	.001125	.0012	.001275	.00135	.001425	.0015
16	.00088	.00096	.00104	.00112	.0012	.00128	.00136	.00144	.00152	.0016
17	.000935	.00102	.001105	.00119	.001275	.00136	.001445	.00153	.001615	.0017
18	.00099	.00108	.00117	.00126	.00135	.00144	.00153	.00162	.00171	.0018
19	.001045	.00114	.001235	.00133	.001425	.00152	.001615	.00171	.001805	.0019
20	.0011	.0012	.0013	.0014	.0015	.0016	.0017	.0018	.0019	.002
30	.00165	.0018	.00195	.0021	.00225	.0024	.00255	.0027	.00285	.003
40	.0022	.0024	.0026	.0028	.003	.0032	.0034	.0036	.0038	.004
50	.00275	.003	.00325	.0035	.00375	.004	.00425	.0045	.00475	.005
60	.0033	.0036	.0039	.0042	.0045	.0048	.0051	.0054	.0057	.006
70	.00385	.0042	.00455	.0049	.00525	.0056	.00595	.0063	.00665	.007
80	.0044	.0048	.0052	.0056	.006	.0064	.0068	.0072	.0076	.008
90	.00495	.0054	.00585	.0063	.00675	.0072	.00765	.0081	.00855	.009
100	.0055	.006	.0065	.007	.0075	.008	.0085	.009	.0095	.01
200	.011	.012	.013	.014	.015	.016	.017	.018	.019	.02
300	.0165	.018	.0195	.021	.0225	.024	.0255	.027	.0285	.03
400	.022	.024	.026	.028	.03	.032	.034	.036	.038	.04
500	.0275	.03	.0325	.035	.0375	.04	.0425	.045	.0475	.05
600	.033	.036	.039	.042	.045	.048	.051	.054	.057	.06
700	.0385	.042	.0455	.049	.0525	.056	.0595	.063	.0665	.07
800	.044	.048	.052	.056	.06	.064	.068	.072	.076	.08
900	.0495	.054	.0585	.063	.0675	.072	.0765	.081	.0855	.09
1000	.055	.06	.065	.07	.075	.08	.085	.09	.095	.10

Weight of Square and Round Iron. Per Foot of Length.

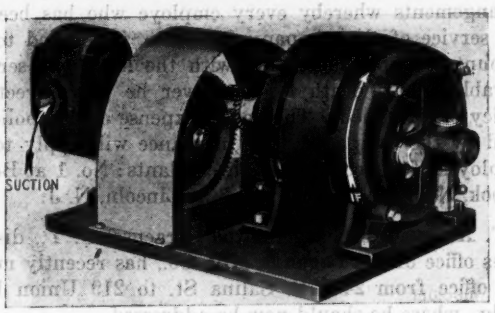
Side or Diam.	Weight, Square.	Weight, Round.	Side or Diam.	Weight, Square.	Weight, Round.	Side or Diam.	Weight, Square.	Weight, Round.
1/16	.013	.01	2	13.52	10.616	5	84.48	66.35
1/8	.053	.041	1/8	15.263	11.988	1/4	93.168	73.172
3/16	.118	.093	1/4	17.112	13.44	1/2	102.24	80.304
1/4	.211	.165	3/8	19.066	14.975	3/4	111.756	87.776
3/8	.475	.373	1/2	21.12	16.588			
1/2	.845	.663	5/8	23.292	18.293	6	121.664	95.552
5/8	1.32	1.043	3/4	25.56	20.076	1/4	132.04	103.704
3/4	1.901	1.493	7/8	27.939	21.944	1/2	142.816	112.16
7/8	2.588	2.032				3/4	154.012	120.96
			3	30.416	23.888			
1	3.38	2.654	1/4	35.704	28.04	7	165.632	130.048
1/8	4.278	3.359	1/2	41.408	32.515	1/4	177.672	139.544
1/4	5.28	4.147	3/4	47.534	37.332	1/2	190.136	149.328
3/8	6.39	5.019				3/4	203.024	159.456
1/2	7.604	5.972	4	54.084	42.464			
5/8	8.926	7.01				8	216.336	169.856
3/4	10.352	8.128	1/4	61.055	47.952			
7/8	11.883	9.333	1/2	68.448	53.76	9	273.792	215.01
			3/4	76.264	59.9			

Motor-Driven Pump for Handling Oils

WM. W. NUGENT & CO., Chicago, Ill., has developed a geared, motor-driven rotary oil pump for oiling systems and for pumping oil from barrels to overhead reservoirs.

Two sizes are obtainable having a delivery of 8 qt. per minute and 40 qt. per minute at 500 r.p.m.

Power is furnished through a noiseless rawhide pinion by a fractional horsepower motor made by the General Electric Co. for the prevailing current. The



NUGENT MOTOR-DRIVEN ROTARY OIL PUMP

motor is controlled through a rheostat and switch box mounted in a convenient location.

Lubrication of Air Compressor Cylinders

RECENT disastrous explosions in air-compressor systems present striking examples of the danger existing from the use of ordinary engine oil in the air cylinders of air compressors. Only a pure mineral oil, with a flash point as high as good lubricating qualities will permit, should be used. As little as possible of even the best oil should be used.

Numerous cylinder oils are compounded, and such oils are likely to produce a carbon that will stick the valves and collect on valve faces and other parts of the cylinder and valve chambers, resulting in a dangerous condition.

Air receivers are liable to explosion from accumulated oil deposits. Every receiver should be equipped with a pressure gage, a safety valve, and proper drains, and all reservoirs and likely places of deposit in the air line should be thoroughly and frequently drained and cleaned. It is bad practice to have the inlet of an air compressor take from a hot or dusty room—the air should be cool and as clean as possible.

The practice of throwing kerosene oil into the inlet of an air compressor to clean it is an extremely dangerous one, and the cause of an explosion under such circumstances is not difficult to understand. Lubrication of the air cylinder with soapsuds (preferably made of soft soap, about one part soap to 15 parts water) for a few hours each week (or less frequently if the load is light), instead of oil, will help very materially in keeping the cylinder clean. The only danger from the use of soapsuds is rust, and this should be overcome by being careful to discard the soap and feed the cylinder with oil an hour or so before shutting down. The receiver blowoff should then be opened and the accumulation of oil and water drained off.

An air-compressor engine should not be controlled by the air pressure alone, as many are, but should be fitted with an auxiliary governor which will act as soon as the speed rises above a certain predetermined limit. This will prevent the engine from "racing" in case an accident to the tanks or piping causes a sudden lowering of the pressure. It is not necessary for an explosion to take place to produce a lowering of the pressure, as the giving way of a pipe, valve or tank from any cause will have the same effect.

A logical lubricant for compressors is graphite, as a graphite lubricator that automatically supplies graphite to compressor cylinders provides not only the safest but the most dependable lubrication possible. If you are interested in the subject, a booklet may be had by writing to Joseph Dixon Crucible Co., Jersey City, N. J.

News Notes

JOSEPH HARRINGTON has recently been elected the vice-president and general manager of the James A. Brady Foundry Co., having charge of the Department of Engineering and Construction.

THE ELECTRIC Hoist Manufacturers' Association held its June meeting at Montour Falls, New York, where the members of the association were the guests of the Shepard Electric Crane & Hoist Co. Twenty-two members were present, representing the following eight companies: Brown Hoisting Machinery Co., Detroit Hoist & Machine Co., Euclid Crane & Hoist Co., Link-Belt Co., Roeper Crane & Hoist Works, Shepard Electric Crane & Hoist Co., Sprague Electric Works, Yale & Towne Mfg. Co.

The general topic of the meeting was war service and the general discussion was directed along the lines for co-ordinating the experience and facilities of the electric hoist manufacturers to be of the most direct and efficient service to the Government for war requirements. The consensus of opinion of the electric hoist manufacturers is that the Government orders for war purposes should take precedence over all other orders and if war requirements call for the complete output of all of the manufacturers of electric hoists, it will be desirable to refuse all other business.

The most instructing and interesting event of the meeting was a detailed inspection of the plan of the Shepard Electric Crane & Hoist Co. covering design, manufacturing, shop costs, testing, technical history of installations and welfare work.

Visiting members of the association were delightfully surprised by the program of entertainment which had been prepared by the Shepard Electric Crane & Hoist Co. to take place after the regular business meeting. This consisted of luncheon at Glen Springs in Watkins, automobile trip to Ithaca and dinner at the new Ithaca Hotel, followed the next morning by an automobile trip from Watkins to Keuka Park, via Tyrone, Keuka Land-

ing and Penn-Yan, with a noon fish dinner at Alleys Inn, Keuka Park. At 1:30 the party left in automobiles for Dresden, Geneva and Valois, arriving at the latter place on Seneca Lake at 4 p. m., where preparations had been made for the party to enjoy trout fishing and motor boating. At 7:30 the guests sat down to a chicken dinner at the Sagoewatha Inn, and at 9:30 left in automobiles for Montour Falls after enjoying for a day and a half the most charming hospitality of the Shepard Electric Crane & Hoist Co.

Members were impressed by the frank manner in which the officials of the Shepard Electric Crane & Hoist Co. opened the entire plant to visiting competitors, an experience unparalleled in the history of electric hoist manufacturers.

A distinct loss was felt by the members in that the secretary-treasurer, R. T. Turner, could not have been present as he had been suddenly called to the colors of his country.

C. W. Beaver,
Vice-Chairman, Acting Secretary.

The Fuel Administration has just announced the appointment of Joseph Harrington, vice-president of the James A. Brady Foundry Co. as the Administrative Engineer for the State of Illinois.

Mr. Harrington's plans are not completed as yet, but it is expected that he will put into effect all of the policies which have been tried and found successful in other states for similar purposes. The entire power plant field will be thoroughly canvassed. Questionnaires will be sent to every power plant in the State and the inspection service will shortly follow up with the personal inspection. In addition to the rather well defined plans for high pressure steam plants, the Conservation Committee for the State will also have its headquarters in Mr. Harrington's office, and such things as curtailment of street lighting, illuminating signs in connection with power plants, the reduction in fuel supply to non-essential industries, etc., will be handled there.

The recent order also provides that the purchase of any new power plant equipment must first receive the approval of the Administrative Engineer. One of the difficulties that the Administrative Engineer has already encountered is the absence of a comprehensive list of power plants. It was found, upon going in this matter, that even the better classes of power plants were unlisted, and that one of the first and most important duties of this office will be to secure such lists. These are for illustration storage warehouses, high pressure apartments, heating plants, laundries, public buildings, etc.

Mr. Harrington has issued invitations to approximately 200 consulting engineers in the State, asking certain questions to bring out their adaptability as advisers to power plant owners and managers throughout the State.

The primary purpose of this office is not to perform a consulting service; and in those instances where it is advisable, a list of consulting engineers familiar with this work will be handed to the owner who will select therefrom some one to do his work as a paid employe.

The National Research Council, acting as the Department of Science and Research of the Council of National Defense, has appointed a committee to investigate the fatigue phenomena of Metals. Professor H. F. Moore of the Engineering Experiment Station of the University of Illinois is chairman.

The committee is charged with the responsibility of developing a knowledge of the strength and durability of metals subjected to repeated stresses, such as ship structures, crank shafts of aircraft engines, and heavy ordnance. It is expected that much of the experimentation required will be done in the laboratories of the University of Illinois at Urbana under the personal direction of Professor Moore.

Bound Brook Oil-less Bearing Co. has perfected arrangements whereby every employe who has been in the service of the company for 3 mo. is insured to the amount of $500, increasing with the length of service, payable at his death to whosoever he may direct the policy to be issued. The entire expense of the policy is paid by the company. The insurance will apply to the employes of the company's three plants: No. 1 at Bound Brook, N. J., and Nos. 2 and 3 at Lincoln, N. J.

T. X. Lieb, in charge of the Syracuse, N. Y., district sales office of the Lagonda Mfg. Co., has recently moved his office from 2400 S. Salina St. to 219 Union Bank Bldg., where he should now be addressed.

Following the recent announcement that John A. Kerley had associated himself with the Dearborn Chemical Co., to be located at the Cincinnati office, numerous inquiries were made regarding Dan Delaney.

The Dearborn Co. hastens to state that Mr. Delaney is not in any way affected by Mr. Kerley's appointment. Mr. Delaney will remain manager of the Cincinnati District, which work he has carried on most successfully for many years.

The government has assumed control of the turbine engine industry. Twenty-one manufacturers of turbines are affected by the order. Manufacturers of turbines under 700 horsepower do not come under the government supervision. The war industries board will supervise filling of orders for turbines of more than that rating.

Trade Notes

TESTS OF THE stoker designed by Geo. A. Kohout have proved most satisfactory, and arrangements are under way for installation of a large plant for its manufacture by Geo. L. Mesker Co. of Evansville, Ind.

THE IDEAL COMMUTATOR DRESSER CO., Chicago, has developed a new commutator resurfacer which is now being marketed. It is designed for use when the commutator to be resurfaced is running under regular load.

This resurfacer is an abrasive material, in block form, conveniently mounted on a handle. It is stated to be non-metallic, non-copper collecting, and therefore will not cause short-circuiting or wear smooth. When held against the revolving commutator, it cuts down high mica bars and high spots and leaves the commutator in perfect condition.